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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

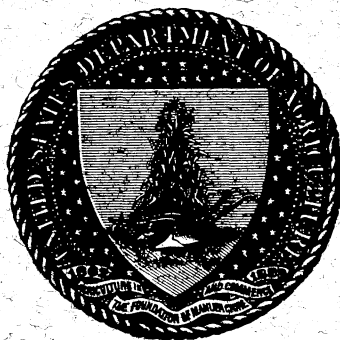
COOPERATIVE EXPERIMENTS WITH GRASSES AND FORAGE PLANTS.

BY

P. BEVERIDGE KENNEDY, Ph. D.,

Expert and Agent in Charge of Experimental Work.

PREPARED UNDER THE DIRECTION OF F. LAMSON-SCRIBNER, AGROSTOLOGIST.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

PUBLICATIONS OF THE DIVISION OF AGROSTOLOGY.

(In applying for these publications the title and Bulletin or Circular number should be mentioned.)

Division
No.

1. Alfalfa. (Farmers' Bulletin No. 31.)
2. A Note of Experimental Grass Gardens. (Circular No. 1.)
3. Grasses and Forage Plants of the Southeastern United States. (Bulletin No. 1.)
4. Hairy Vetch. (Circular No. 2.) Exhausted, and place supplied by Circular No. 6.
5. Saltbushes. (Circular No. 3.) Exhausted, and place supplied by Farmers' Bulletin No. 108.
6. Fodder and Forage Plants Exclusive of Grasses. (Bulletin No. 2.)
7. Useful and Ornamental Grasses. (Bulletin No. 3.) Exhausted, and place supplied by Bulletin No. 14.
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11. Studies on American Grasses: (1) The Genus *Ixophorus*. (2) A List of the Grasses Collected by Dr. E. Palmer in the Vicinity of Acapulco, Mexico, 1894-95. (3) Some Mexican Grasses Collected by E. W. Nelson, 1894-95. (4) Some American Panicums in the Herbarium Berolinense and in the Herbarium of Willdenow. (5) Native and Introduced Species of the Genera *Hordeum* and *Agropyron*. (6) Miscellaneous Notes and Descriptions of New Species. (Bulletin No. 4.)
13. Sorghum as a Forage Crop. (Farmers' Bulletin No. 50.)
14. Grasses and Forage Plants of the Rocky Mountain Region. (Bulletin No. 5.)
15. Grasses and Forage Plants of the Dakotas. (Bulletin No. 6.)
16. American Grasses, Illustrated. (Bulletin No. 7.) Illustrations and descriptions of 302 species of grasses. Exhausted.
18. Studies on American Grasses: (1) Descriptions of New or Little Known Grasses. (2) Leaf Structure of *Jouvea* and *Eragrostis obtusiflora*. (Bulletin No. 8.)
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27. Grasses and Forage Plants of Central Texas. (Bulletin No. 10.)
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34. Economic Grasses. (Bulletin No. 14.)
35. Forage Plants and Forage Resources of the Gulf States. (Bulletin No. 15.)
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37. Experiments in Range Improvement. (Circular No. 8.)
38. Cowpeas. (Farmers' Bulletin No. 89.)
39. New Species of North American Grasses. (Circular No. 9.)
40. American Grasses, Illustrated, II. (Bulletin No. 17.)
42. *Poa Fendleriana* and its Allies. (Circular No. 10.)
43. The Flat Pea. (Circular No. 11.)
44. Rape as a Forage Plant. (Circular No. 12.)
45. Florida Beggarweed. (Circular No. 13.)
46. Studies on American Grasses: A Synopsis of the Genus *Sitanion*. (Bulletin No. 18.)
47. The Structure of the Caryopsis of Grasses with Reference to Their Morphology and Classification. (Bulletin No. 19.)
48. The Velvet Bean. (Circular No. 14.)
49. Recent Additions to Systematic Agrostology. (Circular No. 15.)
50. New Species of North American Grasses. (Circular No. 16.)
51. The Millets. (Farmers' Bulletin No. 101.)
52. Southern Forage Plants. (Farmers' Bulletin No. 102.)
53. Crimson Clover. (Circular No. 17.)
54. Smooth Brome-grass. (Circular No. 18.)
55. Saltbushes. (Farmers' Bulletin No. 108.)
56. New or Little Known Grasses from Mexico. (Circular No. 19.)
57. Experiments with Forage Plants in Ontario. (Circular No. 20.)
58. Cooperative Range Grass and Forage Plant Experiments at Highmore, S. Dak. (Circular No. 21.)
59. Grass and Forage Plant Investigations on the Pacific Coast. (Circular No. 22.)
60. American Grasses, Illustrated, III. (Bulletin No. 20.) Descriptions of the North American Tribes and Genera.
61. Studies on American Grasses: Revision of the North American Species of *Chaetochloa*. (Bulletin No. 21.)
62. Cooperative Experiments with Grasses and Forage Plants. (Bulletin No. 22.)
63. Progress of Experiments with Forage Crops and in Range Improvement at Abilene, Tex. (Circular No. 23.)
64. Cowpeas and Corn for Silage and Fodder. (Circular No. 24.)

REPRINTS FROM THE YEARBOOK.

Year-
book.

1894. Grasses as Sand and Soil Binders.
1895. Grasses of Salt Marshes.
1895. Grass Gardens. Exhausted.
1895. Forage Conditions of the Prairie Region. Exhausted.
1896. Timothy in the Prairie Region.
1896. Cowpeas. (Reprinted and published as Farmers' Bulletin No. 89.)
1897. The Division of Agrostology.
1897. Lawns and Lawn Making.
1897. Leguminous Forage Crops.
1898. Sand-binding Grasses.
1898. Forage Plants for Cultivation on Alkali Soils.
1898. Millets. (Reprinted and published as Farmers' Bulletin No. 101.)

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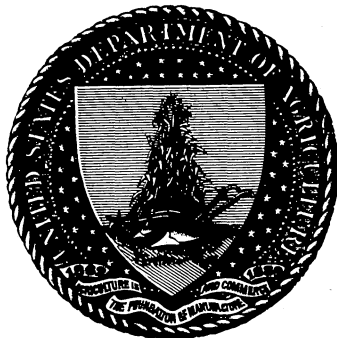
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., January 22, 1900.

SIR: I have the honor to transmit herewith, and recommend for publication as Bulletin No. 22 of this Division, a report on the cooperative experiments carried on during the past three years, prepared under my direction by Dr. P. Beveridge Kennedy, expert in charge of experimental work. During this period seeds of 251 varieties of grasses and forage plants, making nearly 10,000 packages, have been distributed by the Division. Five thousand one hundred and twenty packages have been sent to those whom we term our volunteer experimenters, nearly 3,000 to the agricultural experiment stations, and 1,110 packages have been sent to stations in foreign countries. Two of these stations—one in Cape Colony, South Africa, and one in Australia—have already published interesting reports upon the results obtained from the seeds sent them, and several of our agricultural experiment stations have made the results secured from cultivation of the seeds obtained through this Division the basis of important reports. These distributions have incited a wide-spread and marked interest in a subject of great financial importance to every farmer and stock owner in the country, and while we know our work along these lines has been of direct benefit to many individuals, we are equally confident that the investigations now being carried on and partially noted in this report will advance and improve the farming and grazing interests of the entire country. The report here presented is based almost entirely upon the reports of our volunteer experimenters, and will be of special interest on account of the fact that the testimony given comes directly from the practical farmer.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

HON. JAMES WILSON,
Secretary of Agriculture.

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COOPERATIVE EXPERIMENTS WITH GRASSES AND FORAGE PLANTS.

INTRODUCTION.

The interest in the introduction of useful grasses and forage plants is increasing throughout the country every year. Daily applications are received from farmers who desire to cooperate with the Division in the important work of introduction and trial of new or untried varieties. Thus is created a greater demand for certain varieties which might never have been brought into cultivation except by the efforts of the Department of Agriculture. For example, the smooth brome grass, hairy vetch, Turkestan alfalfa, velvet bean, sulla, Metcalfe bean, slender wheat grass, Western wheat grass, Japanese barnyard millet, and many others may be cited.

The main object is to introduce into cultivation native and foreign varieties of grass and forage plants that are suitable for certain purposes or conditions. Some plants have been found to be excellent drought-resisters; others, on account of their strong, creeping root-stocks, are found to be well adapted to bind the drifting sands of our coasts and lake shores, while still others have the power to resist the trampling of stock and are valuable for reclaiming the cattle ranges of the great West. Demands come from the South, where the land has become exhausted by continuous growing of cotton, for forage plants that will restore the fertility of the soil. There are large tracts of land in the country where the soil is so alkaline that the cultivated grasses will not grow on them. By the introduction of saltbushes on these lands a nourishing forage can be produced which is liked by all kinds of stock. Other requests are made for trial packages of seed suitable for lawns, golf links, fair grounds, and parks in all sections of the United States. The climate and soil conditions of the country are so varied that much study, observation, and experimentation is necessary in order to meet the needs of the different sections and to carry on a wise, useful, and economical distribution.

Since 1896 this Division has distributed 5,120 packages of seed, including 251 varieties of grasses and forage plants, to volunteer experimenters, 2,927 packages to experiment stations and universities, and 1,110 packages to foreign countries, making a total of 9,157 packages.

Farmers to the number of 1,713 in all parts of the United States have complied with the request for a report as to their success or failure with these seeds. We desire here to acknowledge and to thank all those kindly filling out the blanks forwarded to them, thus making possible the production of this report.

This distribution does not include large consignments of grass and forage plant seeds sent to our special agents at Walla Walla, Wash., Abilene, Tex., and Highmore, S. Dak. The detailed reports from these stations on the results obtained are published in Circulars 21, 22, and 23 of the Division of Agrostology.

SEED DISTRIBUTION TO VOLUNTEER EXPERIMENTERS.

Trials of new grasses and forage plants are necessary that ranchers and farmers in all parts of the country may determine their suitability each for his own district. After selection of the promising varieties has been made they can be grown on a larger scale and finally adopted without the useless expenditure of time, money, and labor often attending attempts to grow new forage crops. This introduction of new grasses and the improvement of those already in cultivation is very necessary and important. Many of the ranges have been overstocked and require renewing, and it is a serious question as to what are the best grasses with which to reseed them.

Experiments, to be properly carried on, must receive careful attention; occasional examinations of the plats must be made and the rate of growth and progress carefully noted, so that at the close of the season one can select the varieties that are worthy and suitable for the locality.

During the last three fiscal years 5,120 packages of grass and forage plant seeds, including 251 different varieties, have been distributed by this Division to volunteer experimenters throughout the United States. Table I indicates the variety and the number of packages distributed during the fiscal years 1896-97, 1897-98, 1898-99.

Some of the varieties which have been distributed extensively are Turkestan alfalfa, blue grama, bur clover, dwarf Essex rape, hairy vetch, Japanese barnyard millet, meadow fescue, Metcalfe bean, Russian red clover, rescue grass, Rhode Island bent grass, shad scale, smooth brome grass, slender wheat grass, side oats grama, soy beans, sorghum, sulla, velvet bean, Virginia lyme grass. The seed is obtained for the Division mainly through special agents, who go out into the field during the summer months and collect the seed of those native varieties which by their habit of growth and general appearance seem likely to prove valuable under cultivation. A considerable quantity of seed is also grown at the experiment stations at Walla Walla and Yakima, Wash., and large quantities of a few varieties from foreign

countries have been distributed directly by the Division or through the Section of Seed and Plant Introduction.

TABLE I.—*Number of packages and varieties of grass and forage plant seeds distributed to experimenters, and number and kinds of reports of experiments received.*

No.	Variety.	Number of trial packages distributed to experimenters.				Number and kind of reports received from experimenters.					
		Fiscal year—			Total.	Failures.	Unsatisfactory.	Good.	Excellent.	Total.	
		1896-97.	1897-98.	1898-99.							
1	African millet (<i>Eleusine corocana</i>)		1	2	3	1	2			3	
2	<i>Agropyron acutum</i>		1	2	3						
3	<i>Agropyron dasystachyum</i>			1	1						
4	<i>Agropyron dasystachyum subvillosum</i>			2	2						
5	<i>Agropyron rigidum</i>			1	1						
6	Alfalfa (<i>Medicago sativa</i>)	50	366	159	575	99	27	94	18	148	
7	Alkali saccaton (<i>Panicum bulbosum</i>)		1	2	3						
8	Alpine timothy (<i>Phleum alpinum</i>)										
9	Alsike clover (<i>Trifolium hybridum</i>)	1	22		23		3	1		4	
10	American lyme grass (<i>Elymus americanus</i>)		2	2	4	1				1	
11	American reed bent (<i>Calamagrostis americana</i>)										
12	<i>Andropogon annulatus</i>		4		4	1	1			2	
13	<i>Andropogon laniger</i>		3		3						
14	<i>Andropogon pertusus</i>		3		3						
15	<i>Andropogon saccharoides</i>		1		1						
16	<i>Andropogon schenanthus</i>		1		1						
17	<i>Andropogon scoparius</i>		1		1						
18	<i>Andropogon squarrosa</i>		5		5	2				2	
19	<i>Androsace occidentalis</i>		2		2						
20	Annual saltbush (<i>Atriplex holocarpa</i>)	1	2	26	29	6		1		7	
21	<i>Apluda cristata</i>	1			1						
22	<i>Atriplex angulata</i>			3	3						
23	Australian saltbush (<i>Atriplex semibaccatum</i>)	13	2	3	18	7		1		8	
24	Bearded wheat grass (<i>Agropyron caninum</i>)		1	13	14	7		1		8	
25	Bermuda grass (<i>Cynodon dactylon</i>)	1	12	9	22	3	2	5		10	
26	"Best all round grass"			3	3						
27	Bladder saltbush (<i>Atriplex vesicaria</i>)	2	3		5						
28	Black grama (<i>Hilaria nutica</i>)		4	3	7	1				1	
29	Blue joint grass (<i>Calamagrostis canadensis</i>)	1			1						
30	Blue grama (<i>Bouteloua oligostachya</i>)	51	3	16	70	5	3	6		14	
31	Bowie grass (<i>Panicum effusum</i>)			3	3						
32	Big blue stem (<i>Andropogon provincialis</i>)		6	5	11						
33	<i>Bouteloua mixture</i>			5	5						
34	Broad-leaved spike grass (<i>Uniola latifolia</i>)		1	1	2						
35	Brown's lyme grass (<i>Elymus innovatus</i>)		1		1						
36	<i>Bromus maximus</i>		1	1	2						
37	<i>Bromus pumpeianus</i>		1		1			1		1	
38	Buffalo grass (<i>Bulbilla dactyloides</i>)	2	6	3	11	3		3		6	
39	Buffalo bunch grass (<i>Festuca scabrella</i>)			1	1						
40	Bunch red top (<i>Poa buckleyana</i>)		2	11	13						
41	Bunch spear grass (<i>Poa arida</i>)		1		1						
42	Bunch wheat grass (<i>Agropyron divergens</i>)			11	11						
43	Bur clover (<i>Medicago maculata</i>)		1	29	30	3	2	2		7	
44	Bunshy blue stem (<i>Andropogon nutans</i>)			3	3	1	2	1		4	
45	Button grass (<i>Dactyloctenium australiense</i>)			3	3	1				1	
46	Canadian blue grass (<i>Poa compressa</i>)	5	2	4	11					1	
47	Canadian lyme grass (<i>Elymus canadensis</i>)		2	20	22	2	2	1		6	
48	<i>Calamagrostis sylvatica</i>			1	1						
49	<i>Calamagrostis</i> sp.			1	1						
50	Cane (<i>Arundinaria macrosperma</i>)			1	1						
51	<i>Capnoides aureum</i>		1		1						
52	<i>Carex douglasii</i>		1		1						
53	<i>Cenchrus biflorus</i>		3		3						
54	<i>Chaetochloa glauca</i>		1		1			1		1	
55	<i>Chaetochloa verticillata</i>		1		1						
56	Chick pea (<i>Cicer arretinum</i>)			1	1						
57	<i>Chichorium intybus</i>	1			1	1				1	
58	<i>Chloris barbata</i>		1		1						

TABLE I.—Number of packages and varieties of grass and forage plant seeds distributed to experimenters, etc.—Continued.

No.	Variety.	Number of trial packages distributed to experimenters.				Number and kind of reports received from experimenters.				
		Fiscal year—			Total.	Failures.	Unsatisfactory.	Good.	Excellent.	Total.
		1896-97.	1897-98.	1898-99.						
59	Chloris cucullata		1		1					
60	Crab grass (<i>Eragrostis neo-mexicana</i>)	2	1		3					
61	Crab grass (<i>Panicum sanguinale</i>)		1		1					
62	Creeping bent (<i>Agrostis stolonifera</i>)	2	13	19	34	9	1			10
63	Curly mesquit (<i>Hilaria cenchroides</i>)		7	11	18		1			1
64	Crimson clover (<i>Trifolium incarnatum</i>)	5	1	37	43	7	3	2		12
65	Crowfoot grass (<i>Eleusine Egyptiaca</i>)		2		2					
66	Colorado grass (<i>Panicum texanum</i>)			1	1		1	2		3
67	Cowpeas (<i>Vigna catjang</i>)	2	2		4	4		1	2	7
68	Cyperus rotundus (Nut grass)		1		1					
69	Deccan grass (<i>Panicum frumentaceum</i>)		9	2	11					
70	Desmodium biflorum		1		1					
71	Ditch millet (<i>Paspalum scrobiculatum</i>)		8	1	9	1				1
72	Dogtown grass (<i>Aristida fasciculata</i>)			1	1					
73	Downy brome grass (<i>Bromus tectorum</i>)		1		1			2	1	3
74	Dwarf Essex rape (<i>Brassica napus</i>)		1	60	61	2	2	2	6	12
75	Early bunch-grass (<i>Eatonia obtusata</i>)			1	1					
76	Eleusine stricta		1		1					
77	Elionurus hirsutus		2		2					
78	Elymus ambiguus		1		1					
79	Eragrostis cynosuroides		2		2					
80	Eragrostis stolonifera			1	1					
81	Eragrostis tremula		1		1					
82	Esparto grass (<i>Lygeum spartum</i>)	2	1	1	4					
83	Esparto grass (<i>Stipa tenacissima</i>)		1		1					
84	False quack grass (<i>Agropyron pseudorepens</i>)	1	1	5	7					
85	Fancy red top (<i>Agrostis alba vulgaris</i>)		2	5	7	2		3		5
86	Feather bunch grass (<i>Stipa viridula</i>)			9	9					
87	Festuca arundinacea		4	1	5					
88	Festuca fenas		1		1					
89	Festuca ovina tenuifolia			1	1					
90	Finger grass (<i>Chloris elegans</i>)			1	1					
91	Field peas (<i>Pisum arvense</i>)	2	2	15	19	4	1	2	1	8
92	Fine-top salt grass (<i>Sporobolus airoides</i>)		1	4	5					
93	Flat pea (<i>Lathyrus sylvestris</i>)	9			9	6	1	1	1	9
94	Florida beggar weed (<i>Desmodium tortuosum</i>)	2		1	3	2	1	1		4
95	Fowl meadow grass (<i>Panicularia nervata</i>)			1	1					
96	Foxtail millets (<i>Chaetochloa italica</i>)		29	2	31	1	4	7		12
97	Fresh-water cord grass (<i>Spartina cynosuroides</i>)		2	5	7	1				1
98	German millet (<i>Chaetochloa italica</i> var. <i>germanica</i>)	4			4					
99	Giant brome (<i>Bromus giganteus</i>)		1		1	2				2
100	Giant lyme grass (<i>Elymus condensatus</i>)		4	20	24	2	1	1		4
101	Gracilea royleana		1		1					
102	Gray saltbush	34			34	6	1			7
103	Hairy-flowered lyme grass (<i>Elymus hirsutiglumis</i>)		1	1	2					
104	Hairy vetch (<i>Vicia villosa</i>)	34	332	98	444	86	43	71	6	206
105	Hard fescue (<i>Festuca duriuscula</i>)	1	5	1	7	2	1			3
106	Hooker's brome grass (<i>Bromus hookerianus</i>)			4	4					
107	Hurrah grass (<i>Panicum reticulatum</i>)		4		4					
108	Imperata arundinacea	1			1					
109	Indian grass (<i>Andropogon nutans avenaceum</i>)	11			11					
110	Indian millet (<i>Eriocoma cuspidata</i>)		3	3	6					
111	Isellema wrightii	1			1					
112	Italian rye grass (<i>Lolium italicum</i>)			20	20	4		1		5
113	Japan clover (<i>Lepedeza striata</i>)	1			1	1				1
114	Japanese barnyard millet (<i>Panicum crus-galli</i>)	7	12	59	78	14	5	10		29
115	Japanese lawn grass (<i>Zoysia pungens</i>)	4	2	1	7					
116	Jerusalem corn (<i>Andropogon sorghum vulgaris</i>)			12	12	3	1			4
117	Johnson grass (<i>Andropogon halapense</i>)	1	3		4	2		4		6
118	Kafir corn (<i>Andropogon sorghum vulgaris</i>)			13	13	2	1	1		4

TABLE I.—Number of packages and varieties of grass and forage plant seeds distributed to experimenters, etc.—Continued.

No.	Variety.	Number of trial packages distributed to experimenters.			Number and kind of reports received from experimenters.				
		Fiscal year—			Total.	Failures.	Unsatisfactory.	Good.	Excellent.
		1896-97.	1897-98.	1898-99.					
119	Kentucky blue grass (<i>Poa pratensis</i>)		2	15	17	2			2
120	King's fescue (<i>Festuca kingii</i>)			10	10				
121	Koeleria valesiaca		1		1				
122	Langsdorff's reed bent (<i>Calamagrostis langsdorffii</i>)			6	6				
123	Lappula redouski.		1		1				
124	Large water grass (<i>Paspalum dilitatum</i>)		1	2	3				
125	Leptochloa dubia.		2	1	3				
126	Lentils (<i>Eryum lens</i>)	1	4	14	19	2	2		4
127	Lesquerella gordonii.		1		1				
128	Lotus americanus.		1		1				
129	Lupine (<i>Lupinus</i> sp.)			1	1				
130	Marram Grass (<i>Ammophila arenaria</i>)	3			3				
131	Meadow foxtail (<i>Alopecurus pratensis</i>)			14	14				
132	Medicago media		4	7	11				
133	Meadow fescue (<i>Festuca pratensis</i>)		387	37	424	46	18	44	3
134	Melica altissima			2	2				
135	Metcalfe bean (<i>Phaseolus retusus</i>)			22	22	1	2	3	
136	Mitchell grass (<i>Astrebala pectinata</i>)		1		1				
137	Mixed sand grasses			2	2				
138	Mogollon vetch (<i>Vicia</i> sp.)	2	2		4	1			1
139	Mollusc verticillata		1		1				
140	Molinia coerulea.			1	1				
141	Montana reed bent (<i>Calamagrostis montanensis</i>)			3	3				
142	Mountain spear grass (<i>Poa alpina</i>)		1	1	2				
143	Mungrove millets from South Africa		1		1				
144	Mutton grass (<i>Poa fendleriana</i>)		7	2	9				
145	Nelson's saltbush (<i>Atriplex pabularis</i>)		6		6				
146	Northern red top (<i>Agrostis exarata</i>)			4	4				
147	Northern spear grass (<i>Poa nemoralis</i>)			16	16				
148	Northern wheat grass (<i>Agropyron violaceum</i>)		2		2				
149	Nuttall's saltbush (<i>Atriplex nuttallii</i>)		4		4	1			1
150	Old man's saltbush (<i>Rhagodia parabolica</i>)	8			8	2			2
151	Orchard grass (<i>Dactylis glomerata</i>)	2			2	2			3
152	Oryza sativa			1	1				
153	Panicum decompositum		1		1				
154	Panicum floridanum		1		1				
155	Panicum hallii.			1	1				
156	Panicum avenaceum			2	2				
157	Panicum humile.		3		3				
158	Panicum javanicum.		1		1				
159	Panicum violaceum		1		1				
160	Panicum sanguinale.		2		2				
161	Panicularia sp.			1	1				
162	Poa flava.		1		1				
163	Poa laevigata.			18	18				
164	Poa wheeleri.			3	3				
165	Poa sp.			1	1				
166	Pasture mixture			9	9				
167	Purple reed bent (<i>Calamagrostis purpurascens</i>)			1	1				
168	Quack grass (<i>Agropyron repens</i>)			1	1				
169	Red clover (<i>Trifolium pratense</i>)		329	15	344	74	18	53	7
170	Red fescue (<i>Festuca rubra</i>)		7	21	28	4			4
171	Red lump millet (<i>Panicum miliaceum</i>)	15	345		360	63	37	60	166
172	Red top (<i>Agrostis alba</i>)	1	7	2	10	3		4	7
173	Reed canary grass (<i>Phalaris arundinacea</i>)	1		3	4				
174	Rescue grass (<i>Bromus unioloides</i>)	2		46	48	4	1	4	10
175	Rhode Island bent (<i>Agrostes canina</i>)	3	17	27	47	7		1	8
176	Richardson's wheat grass (<i>Agropyron richardsonii</i>)	1			1	1		1	2
177	Rocky mountain hair grass (<i>Deschampsia caespitosa</i>)	2	9		11				
178	Rough-stalked meadow grass (<i>Poa trivialis</i>)			1	1				
179	Round-leaved saltbush (<i>Atriplex nummularia</i>)	8			8	2	1		3
180	Saccaton (<i>Muhlenbergia distichophylla</i>)	10			10	6			6

TABLE I.—Number of packages and varieties of grass and forage plant seeds distributed to experimenters, etc.—Continued.

No.	Variety.	Number of trial packages distributed to experimenters.				Number and kind of reports received from experimenters.				
		Fiscal year—			Total.	Failures.	Unsatisfactory.	Good.	Excellent.	Total.
		1896-97.	1897-98.	1898-99.						
181	Saccaton (<i>Sporobolus wrightii</i>)			2	2					
182	Saccharum spontaneum		2		2					
183	Sand bur (<i>Cenchrus tribuloides</i>)			1	1					
184	Sainfoin (<i>Onobrychis sativa</i>)	1		17	18	2	1	2		5
185	Sand rush-grass (<i>Sporobolus depauperatus</i>)		1	2	3					
186	Sapling clover (<i>Trifolium media</i>)			19	19	1				1
187	Seaside blue grass (<i>Poa macrantha</i>)			18	18	4				4
188	Serradella (<i>Ornithopus sativa</i>)	2			2	1				1
189	Shad scale (<i>Atriplex canescens</i>)	78	5	2	85	11		10		21
190	Shama millet (<i>Panicum colonum</i>)		6		6	3				3
191	Short-awned brome (<i>Bromus brevilaristatus</i>)		1	27	28			2		2
192	Sheep's fescue (<i>Festuca ovina</i>)		1	17	18	3				3
193	Side oatsgrama (<i>Bouteloua curtipendula</i>)	60	4	7	71	3	7	9		19
194	Silvery salt sage (<i>Atriplex argentea</i>)		4	8	12	2				2
195	Six weeksgrama (<i>Bouteloua polystachya</i>)		3	3	6					
196	Slender-fruited saltbush (<i>Atriplex leptocarpa</i>)	18		3	21	6		1		7
197	Slender wheat grass (<i>Agropyron tenerum</i>)		49	40	89	7	7	14		28
198	Slough grass (<i>Beckmannia erucaeformis</i>)	1		7	8					
199	Smooth brome (<i>Bromus inermis</i>)	29	401	106	536	88	63	121	32	284
200	Smooth lyme grass (<i>Elymus glaucus</i>)		1	1	2					
201	Snail clover (<i>Medicago turbinata</i>)		2		2					
202	Southern canary grass (<i>Phalaris caroliniana</i>)		5	2	7					
203	Soy bean (<i>Glycine hispida</i>)	26	39	86	151	12	7	10	3	32
204	Spiny salt sage (<i>Atriplex confertifolia</i>)		7		7	2				2
205	Sporobolus arabicus	7			7					2
206	Sporobolus cryptandrus			3	3					
207	Sporobolus richardsoni	1			1					
208	Spongy saltbush (<i>Atriplex spongiosum</i>)	2			2					
209	Sorghum (<i>Andropogon sorghum vulgaris</i>)	24	23	16	63	9	3	12	7	29
210	Sprangle top (<i>Scolochloa festuacea</i>)			9	9					
211	Squirrel grass (<i>Hordeum murinum</i>)		1		1					
212	Stink grass (<i>Eragrostis major</i>)			1	1					
213	Stolley's vetch (<i>Vicia leavenworthii</i>)		8	2	10	4	1	1		6
214	Sulla (<i>Hedysarum coronarium</i>)			29	29	5		1		6
215	Swamp chess (<i>Bromus ciliatus</i>)			3	3					
216	Sweet clover (<i>Melilotus alba</i>)		1		1					
217	Switch grass (<i>Panicum virgatum</i>)			1	1					
218	Sysymbrium canescens		2		2					
219	Tall fescue (<i>Festuca elatior</i>)		4	10	14	2				2
220	Tall oat grass (<i>Arrhenatherum elatius</i>)		7	4	11			1		1
221	Teosinte (<i>Euchlaena mexicana</i>)		7	3	10	2		1		3
222	Teff (<i>Eragrostis abyssinica</i>)		1	2	3					
223	Texas blue grass (<i>Poa arachnifera</i>)		1		1					
224	Texan grama (<i>Bouteloua texana</i>)		1	1	2					
225	Texan timothy (<i>Lycurus pleoides</i>)	6			6	1				1
226	Tetradynia canescens		1		1					
227	Timothy (<i>Phleum pratense</i>)		1		1					
228	Top grama (<i>Bouteloua juncifolia</i>)	21	2	1	24	1	1	7		9
229	Trifolium involucreatum		1	6	7					
230	Tsama watermelon (<i>Citrullus vulgaris</i>)		1	2	3			2		2
231	Tweedy's feather grass (<i>Stipa tweedyi</i>)			5	5					
232	Twisted beard grass (<i>Andropogon contortus</i>)		2		2					
233	Uniola laxa		1		1					
234	Uniola longipipes		1		1					
235	Upright chess (<i>Bromus racemosus</i>)		1		1					
236	Utah saltbush (<i>Atriplex truncata</i>)	3			3					
237	Various-leaved fescue (<i>Festuca heterophylla</i>)		12	4	16	1				1
238	Velvet bean (<i>Mucuna utilis</i>)		19	15	34	3	2	8	6	19
239	Velvet grass (<i>Holcus lanatus</i>)		1		1					
240	Veronica peregrina		1		1					
241	Virginia lyme grass (<i>Elymus virginicus</i>)	1	6	19	26	3	2	1		6
242	Western wheat grass (<i>Agropyron spicatum</i>)	1	7	22	30	4	1			5

TABLE I.—*Number of packages and varieties of grass and forage plant seeds distributed to experimenters, etc.—Continued.*

No.	Variety.	Number of trial packages distributed to experimenters.				Number and kind of reports received from experimenters.				
		Fiscal year—			Total.	Failures.	Unsatisfactory.	Good.	Excellent.	Total.
		1896-97.	1897-98.	1898-99.						
243	White clover (<i>Trifolium repens</i>).....		1	6	7					
244	Wild chess (<i>Bromus kalmii</i>).....		1	3	4			1		1
245	Wild timothy (<i>Muhlenbergia racemosa</i>).....		3	12	15					
246	Windmill grass (<i>Chloris verticillata</i>).....			1	1					
247	Winter fat (<i>Eurotia lanata</i>).....	35	4		39	10	1			11
248	Wyoming blue grass (<i>Poa wheeleri</i>).....			3	3					
249	Woolly bent grass (<i>Calamovilfa longifolia</i>).....				2					
250	Woolly-jointed grama (<i>Bouteloua eriopoda</i>).....	2	2		4					
251	Yellow spear grass (<i>Poa lucida</i>).....		1	5	6					
	Total.....	632	2,749	1,739	5,120	718	287	607	101	1,713

SEED DISTRIBUTION TO EXPERIMENT STATIONS, BOTANICAL GARDENS, AND UNIVERSITIES.

An important work of the Division has been to supply the experiment stations throughout the United States with grass and forage-plant seeds for experimental purposes. Many of these varieties could not easily be obtained in any other way, as they are not on the market.

By examination of Table II it will be seen that during the last three fiscal years 2,927 packages have been distributed to 33 experiment stations, 2 universities, and 1 botanical garden. The stations receiving the largest number of varieties were those in Arizona, California, Iowa, Kansas, Nebraska, Ohio, Oregon, South Dakota, Tennessee, Texas, Washington, and Wyoming. These lots averaged 135 different varieties of grass and forage plants. The results of the experiments have not in all cases been reported to the Division, but were published in the various bulletins and reports of the stations, to which the reader is referred for detailed information.

The receipt of reports from the experiment stations of Alabama, Arizona, Georgia, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Washington, Wyoming, Cornell University, and California is here acknowledged. The results of this distribution are now being compiled and will be published later as a separate report from this division.

TABLE II.—*Number of packages of grass and forage plant seeds distributed to experiment stations and universities.*

Experiment station or university.	Fiscal year.			Total.
	1896-97.	1897-98.	1898-99.	
Alabama Experiment Station, Auburn, Ala.	17	1	.....	18
Arizona Experiment Station, Tucson, Ariz.	135	.....	.....	135
California Experiment Station, Berkeley, Cal.	135	2	2	139
Florida Experiment Station, Lake City, Fla. ....	.....	1	.....	1
Georgia Experiment Station, Experiment, Ga.	45	1	.....	46
Hatch Experiment Station, Amherst, Mass.	13	.....	.....	13
Idaho Experiment Station, Moscow, Idaho.	6	50	36	92
Illinois Experiment Station, Urbana, Ill.	5	.....	.....	5
Iowa Experiment Station, Ames, Iowa.	135	.....	11	146
Kansas Experiment Station, Manhattan, Kans.	140	.....	.....	140
Louisiana Experiment Station, Calhoun, La. ....	.....	1	.....	1
Maryland Experiment Station, College Park, Md.	7	.....	.....	7
Michigan Experiment Station, Lansing, Mich.	63	.....	.....	63
Minnesota Experiment Station, St. Anthony Park, Minn.	67	.....	.....	67
Minnesota sub-Experiment Station, Crookston, Minn.	2	.....	.....	2
Missouri Experiment Station, Columbia, Mo. ....	.....	3	.....	3
Montana Experiment Station, Bozeman, Mont.	72	22	.....	94
Nebraska Experiment Station, Lincoln, Nebr.	132	.....	.....	132
Nevada Experiment Station, Reno, Nev.	5	.....	.....	5
New Mexico Experiment Station, Mesilla Park, N. Mex. ....	.....	.....	51	51
New York Experiment Station, Geneva, N. Y.	8	.....	.....	8
North Dakota Experiment Station, Fargo, N. Dak.	79	.....	.....	79
Ohio Experiment Station, Wooster, Ohio.	114	.....	.....	114
Oklahoma Experiment Station, Stillwater, Okla.	71	.....	.....	71
Oregon Experiment Station, Corvallis, Ore.	140	.....	.....	140
Rhode Island Experiment Station, Kingston, R. I.	5	.....	.....	5
South Dakota Experiment Station, Brookings, S. Dak.	141	11	.....	152
Tennessee Experiment Station, Knoxville, Tenn.	74	45	.....	119
Texas Experiment Station, College Station, Tex.	115	.....	.....	115
Utah Experiment Station, Logan, Utah.	79	.....	5	84
Washington Experiment Station, Pullman, Wash.	128	.....	1	129
Wisconsin Experiment Station, Madison, Wis.	7	.....	.....	7
Wyoming Experiment Station, Laramie, Wyo.	135	.....	133	268
Cornell University, Botanical Department, Ithaca, N. Y.	122	9	114	245
New York Botanical Gardens, New York City.	84	.....	.....	84
Washington-Lee University, Lexington, Va. ....	.....	38	109	147
Total.....	2, 281	184	462	2, 927

SEED DISTRIBUTION TO FOREIGN COUNTRIES.

A large number of packages of grass and forage-plant seeds have been distributed by the Division to foreign countries, from many of which we have received in return seeds of promising varieties for cultivation in this country.

By examining Table No. III it will be seen that 1,110 packages have been distributed during the last three years. Many requests are received for seed for purely botanical purposes, so that only small packages have been sent out. In 1897, 122 varieties of grass and forage-plant seeds were sent to Prof. D. McAlpine, the government vegetable pathologist for the Department of Agriculture, at Victoria, New South Wales, the object being to test their growth under different conditions of soil, climate, and moisture, but mainly to prove their drought-resisting properties. Twenty-one of these grasses resisted drought, and of these seven were very conspicuous for their fresh green growth. Among the forage plants other than the grasses, two were found to be suitable to Australian conditions and very resistant to drought. These were hairy vetch and a variety

of the much-branched knotweed (*Polygonum ramosissimum*). Of the wheat grasses tested, bearded wheat grass, slender wheat grass, Western wheat grass, and false couch grass were found to resist drought well and to form a close, dense, grassy, succulent sward, especially the two last-named species. Among the lyme grasses 5 species were tested and 3 found to be highly drought resisting, viz, Canada lyme grass, giant lyme grass, and Virginia lyme grass. Eleven different fescues were tried, and only two, reed fescue and tall meadow fescue, proved to be of value, the latter forming a dense, succulent, grassy sward. Of the panic grasses 5 varieties were tested and 3 germinated, viz, the barnyard millet, deccan grass, and switch grass. The barnyard millet did remarkably well and produced a succulent growth 3 feet high. Out of the 16 forage plants not belonging to the true grasses only 3 germinated, viz, Dakota vetch (*Hosackia purshiana*), much-branched knotweed (*Polygonum ramosissimum*), and hairy vetch (*Vicia villosa*). The Dakota vetch produced a poor and straggling growth. The knotweed grew freely, branching and spreading, and attaining a height of 4½ feet. It withstood the drought well, but after the leaves fell off it became rather woody. Horses were very fond of the foliage. The hairy vetch grew luxuriantly and freely. It germinated in 20 days and rapidly formed a tangled mass of vegetative growth. It has been reported as a weed from some parts of Victoria; however there is little doubt but that it will prove to be an excellent soiling crop and green manure in Australia as well as here.

Dr. P. MacOwan, the government botanist for Cape Colony, also received 123 packages of grass and forage-plant seeds from this Division in 1897. Out of these the grama grasses and buffalo grass have proved to be of some value, and among the forage plants other than the grasses the velvet bean and Metcalfe bean are promising varieties, the former now being widely distributed by the Government at about 80 cents per pound.

Five pounds of seed of velvet bean were sent to the department of agriculture of New Zealand, and it is now being widely distributed in that country. It thrives well in the vicinity of Brisbane, Queensland, and is commonly regarded as a valuable addition to the forage plants of northern New Zealand. Favorable reports have also been received from Prof. J. F. Duthie, of Saharanpoor, Northwest Province, India, in regard to the introduction of the Metcalfe bean.

TABLE III.—*Number of packages of grass and forage plant seeds distributed to foreign countries.*

Country.	Fiscal year.			Total.
	1896-97.	1897-98.	1898-99.	
Africa:				
Capetown, Cape Colony, Dr. P. MacOwan	121	1	1	123
Mustappa, Algeria, Prof. L. Trabut	1			1
Durban, Natal, Prof. J. Medley Wood	122			122
Tunis, Algeria, l'Directeur de l'Agriculture et du commerce			6	6
Argentine Republic:				
La Plata, Dr. Antonia, general director of the department of agricultural chemistry		20		20
Australia:				
Adelaide, Hon. A. Molineux, secretary of agriculture	122			122
Melbourne, Prof. D. McAlpine, department of agriculture	122			122
North Queensland, Town Hall, Charles Towers and Henry O. Walkers	2			2
Victoria, Ruffy Post-office, J. H. Noiya	6			6
Canada:				
Ottawa, experiment station, Prof. J. Fletcher	135			135
Toronto, King street, East, J. A. Simmers			3	3
Central America:				
Honduras, Dr. R. Fritzgartner, director of mint	6			6
England:				
Royal Botanical Gardens, Kew	112			112
Cirencester, Frank McClellan			20	20
Oxford, 80 Woodstock road, Prof. R. B. Townsend		3		3
Egypt:				
Ghezeh, School of Agriculture, Prof. W. C. Mackenzie, director			6	6
France:				
Limoges, M. Ch. Le Gendre		4		4
Holland:				
Middleburg, M. Buysman			42	42
India:				
Saharanpoor, Northwest Province, Prof. J. F. Duthie	121	1		122
Madeira:				
Funchal, J. B. Blandy		1	1	2
Mexico:				
Santa Cruz, J. Lawton Taylor		6		6
Samoa:				
Apia, Hon. William Churchill, United States consul-general	6			6
Switzerland:				
Zurich, director seed-control station	119			119
Total	995	36	79	1,110

REPORTS RECEIVED FROM VOLUNTEER EXPERIMENTERS.

The cooperation which the Division has received from farmers in all parts of the country is very gratifying. It proves that they are alive to their own interests and are anxious to become familiar with newly tried or recently introduced grasses and forage plants that are likely to prove of considerable value under cultivation. By examination of the table on page 11, it will be seen that a total of 1,713 reports has been received in answer to 5,120 packages of seed sent out. This large difference is mainly due to the fact that when the seed was first distributed in 1896-97 no report blanks were sent or requests made for a report as to the results of the experiments, and, in some cases in later years, by neglect on the part of the experimenter to take notes on the plants during their growth. In consequence of this they had not the necessary knowledge to fill out the blanks forwarded them and so neglected sending in a report of any kind.



FIG. 1.—BUNCH WHEAT GRASS (*AGROPYRON DIVERGENS*), U. S. GRASS STATION AT WALLA WALLA, WASH.



FIG. 2.—BUNCH WHEAT GRASS (NATURAL GROWTH), OREGON.

From a photograph by A. B. Leckenby.

During the years 1898 and 1899 blanks for reports were sent to all those receiving seed from this Division for trial, containing the following questions:

- (1) Kind, conditions, and preparation of soil?
- (2) Date and method of planting?
- (3) Cultivation, if any?
- (4) Date of harvesting and stage of maturity reached when harvested?
- (5) Date of ripening?
- (6) Yield per acre (if practicable)?
- (7) Quality of product?
- (8) Notes on growth, probable, value, etc.?

It will be noticed that there are many varieties in the table which have been reported on and yet are not included in this report, there being 251 varieties sent out and only 40 discussed. The reason for this is that the economic value of the others has not been sufficiently demonstrated to warrant a report on them at this time. The number of reports is given in the table on page 11, under the following divisions: Excellent, 101; good, 607; unsatisfactory, 287; failures, 718.

The largest number of reports have been received on the following varieties: Smooth brome-grass, 284; hairy vetch, 206; red lump millet, 166; red clover, 152; alfalfa, 148; and meadow fescue, 101.

VARIETIES OF SEED EXPERIMENTED WITH AND TESTIMONY OF EXPERIMENTERS.

BUNCH WHEAT GRASS (*Agropyron divergens*).

(Plate I, figs. 1 and 2.)

A slender, usually densely tufted native grass, 1 to 2 feet or more high, with very narrow spreading leaves and usually bearded spikes. This grass is common in the Rocky Mountain and Pacific Slope regions, extending westward to the coast. When grown upon good soil it possesses much agricultural value and is considered by ranchmen as a good grass for winter grazing. As it will thrive in the semiarid regions of the Northwest, its cultivation should be carried on more extensively. Seeds of this variety were sent to 11 experimenters, but no reports have yet been received.

Our special agent at Walla Walla, Wash., from the results of experiments carried on at the station, considers it one of the best grasses for reclaiming the worn-out ranges, as it thrives under conditions of extreme drought and affords excellent pasturage for all kinds of stock.

WESTERN WHEAT GRASS (*Agropyron spicatum*).

A rigid, upright, perennial, native grass, 1½ to 2½ feet high, with foliage, spikes, and rootstocks closely resembling the common couch grass of the Eastern States. The whole plant differs, however, from

the quack grass in having a bluish color, and on this account has received the name "blue stem." This grass is quite distinct from the blue-stem grasses of Nebraska and other Western States, which are *Andropogons*. In its native state western wheat grass is found growing on bench lands and river bottoms. It grows luxuriantly all over central Texas and withstands the droughts to which that section of the country is periodically subjected. While it will not produce as much hay to the acre as some other species, stockmen value it highly for its nutritive qualities. In Montana and the neighboring States it furnishes a considerable amount of native hay and pasturage, and is there regarded as one of the most important forage plants. This grass would make excellent hay, and should be introduced into cultivation.

Thirty experimenters were supplied with seed of western wheat grass by this Division in the spring of 1899, but only 5 have reported, with 1 satisfactory result. The large number of failures is probably due to lack of knowledge of the best time and method of sowing the seed of this grass.

Mr. George T. McWhorter, Riverton, Colbert County, Ala., writes:

The seed was sown broadcast on a deep, smooth bed on March 1, 1899. It germinated and grew moderately well, then died down during the drought, but revived again after the light fall rains. So far it is a promising variety.

SLENDER WHEAT GRASS (*Agropyron tenerum*).

A valuable native perennial grass about 3 to 4 feet high, with numerous soft leaves and a long, slender, erect spike. It is found growing wild in dry soil from New Mexico and southern California to Washington and British Columbia and eastward to New Hampshire and Labrador. It responds readily to cultivation and produces excellent results when slightly irrigated. When well grown it forms a close, uniform growth that yields as much per acre as an average field of timothy. Considering its high nutritive value no more profitable grass can be found for dry regions, especially on saline soils. It is one of the most valuable grasses for the Rocky Mountain region. During the years 1898 and 1899, 89 three-pound packages of the seed of slender wheat grass were distributed. This distribution includes experimenters in 12 different States. Twenty-eight reports have been received from 10 different States, very favorable ones having been received from Colorado, Idaho, Montana, and South Dakota.

The following reports will indicate its value in some sections of the country:

Mr. Marion Flaherty, Bozeman, Gallatin County, Mont.:

The slender wheat grass made a good growth, at least 2 feet high. Stock eat it as well as clover or timothy. I think wheat grass will make a valuable feed for young stock. I want to try it on a larger scale next year.

Mr. Ellis M. Cameron, Post Falls, Kootenai County, Idaho:

The seed was received very late and did not have a fair chance, but it came up evenly and maintained a strong, vigorous growth all through the extremely hot weather until destroyed by grasshoppers. It is the most vigorous grass I have ever tested in this country and is a very valuable forage plant.

Mr. W. H. H. Phillips, Brookings, Brookings County, S. Dak.:

I am very much pleased with this grass. I judge that it would produce at least 2 tons of hay per acre. It crowded out every weed and other grass, and even took a good hold on a small piece of sod. We need such a grass for our weedy pastures.

RHODE ISLAND BENT GRASS (*Agrostis canina*).¹

This species of bent grass was introduced from Europe, and is now cultivated to some extent in the Eastern States for lawns, golf links, tennis courts, polo grounds, and occasionally for permanent meadows and pastures. In beauty and texture it is surpassed only by the creeping bent. The seed may be sown from the middle of April to the middle of May, or from the middle of August to the middle of September. If sown in the spring, it should be done as early as the land is in suitable condition, in order that the young plants may become sufficiently well established to withstand the often dry and hot summer months. The seed should be scattered evenly over the surface, and not covered by more than one-eighth of an inch of earth.

Since 1896 seed of this variety has been sent to forty-six experimenters, eight of whom have sent in reports, and only one of these is favorable. Most of the others failed to get the seed to germinate satisfactorily. These failures are in some instances due to requests for seed to be sown in parts of the South and Southwest, where it would be almost impossible without the greatest care to get a stand of this grass. In others they are due to the small quantity of seed (1 quart) sent out, and the difficulty in recognizing the young plants, which are very small. When seeding down a lawn, a liberal quantity should always be used. As a rule, about 1½ pounds to 100 square yards or 3 to 4 bushels per acre is sufficient, poor land requiring more seed than fertile land.

The following report has been received:

Mr. James Hines, Anaconda, Teller County, Colo.:

A good, black, well-prepared sandy loam was used. The seed was sown about the middle of June. It is doing nicely, and has not winterkilled.

CREEPING BENT (*Agrostis stolonifera*).¹

A fine-leaved, hardy, native, perennial grass with long, prostrate, or creeping stems, which spread very rapidly and form an excellent velvety turf for lawns. In texture it far surpasses any of the other lawn grasses. The color of the lawn produced by it is somewhat lighter

¹See "Lawns and Lawn Making," by F. Lamson-Scribner, in Yearbook of Department of Agriculture for 1897, p. 355.

than Kentucky blue grass; but if this be regarded as a fault, it is fully counterbalanced by its superior turf-forming habit. When a lawn is desired within a short space of time and a small portion of turf is accessible, it may be carefully cut and divided into pieces 2 or 3 inches square, and transplanted about 6 to 8 inches apart. If the soil has been properly prepared, the grass will spread entirely over the whole surface in less than three months, and make a more certain and satisfactory lawn than can be obtained by seeding.

When seed is used, it may be sown from the middle of March to the middle of April, when it will produce an excellent turf by September, providing the soil has been well prepared. Seed may also be sown in the fall, but it must be done early enough to secure a good strong growth before winter sets in. Twenty pounds of seed per 100 feet square or 3 bushels per acre is recommended for the best results. In the far South and Southwest, creeping bent can not be successfully grown.

Thirty-four experimenters have been supplied with trial packages by this Division since 1896, 9 of whom have complied with the request for a report. In 3 cases the seed germinated well, but was killed out by long-protracted drought, while in the other cases the seed failed to germinate.

"M. B." SORGHUM (*Andropogon sorghum vulgaris*).¹

This variety of sorghum was originated by Miss Mary Best, of Medicine Lodge, Kans.; hence the name "M. B." Sorghum. A considerable quantity of seed was sent by her to the Department, and a portion of it was distributed by this Division as follows: To 3 experimenters in Florida, 6 in Georgia, 2 in Mississippi, 2 in Nebraska, 2 in South Dakota, 1 in Texas, and 1 in Virginia. Eleven out of the 17 receiving the seed sent in reports, of which the following are representative:

Mr. Philip D. Cory, Keller, Bryan County, Ga.:

This plant impresses me favorably. It is earlier than Orange and is a more vigorous grower. I regret that circumstances have prevented me from making a sirup test. Our stock—horses, cattle, hogs are unequivocal in their commendation of it as a forage plant.

Mr. A. T. George, Cuthbert, Randolph County, Ga.:

It is very fine; nothing better. As it grows very quickly, its value cannot be excelled. There is nothing better either to feed green or to cure and feed dry. It makes more forage to the acre than anything else we sow, and is excellent for all kinds of stock.

Mr. J. L. Stevens, Waldo, Alachua County, Fla.:

I think it is a good forage plant for Florida. It did very well, even though it was planted late in the season.

¹For discussion of "Sorghum as a forage crop," see Farmers' Bulletin No. 50, U. S. Department of Agriculture. (Agros. 13.)



JOHNSON GRASS IN GRASS GARDEN ON GROUNDS OF UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

Hon. H. C. Warner, Forestburg, Sanborn County, S. Dak.:

This variety was grown in comparison with amber cane, and had greater leafage and suckers. It was dried in the shock and then fed to milch cows, which ate the leaves and heads readily, but would not eat the stalks. It is not, however, as profitable as corn for this section.

JOHNSON GRASS (*Andropogon halepensis*).

(Plate II.)

A stout perennial with smooth, erect stems, 3 to 8 feet or more high, and strong, creeping rootstocks. It is a native of southern Europe and the warmer parts of Asia and northern Africa. Its introduction into this country is said to have occurred as follows: In 1840 the Sultan of Turkey wrote to Governor Means of South Carolina asking that he send a competent man to teach his subjects how to raise cotton. A Colonel Davis was sent, and upon his return he brought back many valuable seeds, among which was the seed of what was there called Sicily grass. In 1845 Mr. William Johnson, of Alabama, went to South Carolina, where he obtained some of this seed, which he brought home in his saddlebags and sowed in his plantation, where it still grows. From this farm much of the seed was obtained at that time; hence the name Johnson Grass. This grass has now become widely distributed and well known throughout the Southern States, where it is much valued for hay, if cut at the time of full bloom. Because of its rapid growth, it will give from 2 to 4 cuttings yearly, and each cutting will make from 1 to 2 tons of hay. The serious objections to its cultivation are the great difficulty of destroying it when the land is required for other purposes, and the ease with which it spreads to fields where it is not wanted.

Mr. Herbert Post, formerly of Alabama, now of Fort Worth, Tex., gives the following method of eradication:

Don't expect to get rid of this grass by spring or summer cultivation. It can not be done. In the month of August the summer growth has about ceased. With a strong team and a 2-horse plow break up the ground to the depth of 6 inches, leaving the furrows as high and rough as possible. The action of the elements mellows the soil and all exposed roots die. In two or three weeks, with a straight-toothed harrow (not slanting), cross the furrows and draw the remaining roots to the surface, where they will soon die. Your hogs would delight to have them. When ready to put in fall grain, plow again across the furrows to the depth of 8 inches; harrow well, and sow wheat, barley, oats, or rye. Pasture during the winter and early summer, and cut the crop for hay or summer feed. On the stubble sow broadcast 2 bushels of cowpeas, and harrow them in. In early fall cut the vines for hay, or, what will be still better for the land, plow the vines under while still green. Now you are rid of the Johnson grass, and you can plant any crop you desire, as the roots of this grass, cut off 8 inches below the surface, will decay.

Very little seed of this grass has been distributed by the Division, as the farmers are very much prejudiced against it and are afraid to sow it. Those who have given it a trial, however, report it a great

success, excellent reports having been received from Louisiana, Mississippi, and Texas. Many others, however, condemn it very strongly and look upon it as one of the most dangerous weeds. The following are some of the reports for and against the cultivation of this grass:

Mr. Herbert Post, Fort Worth, Tex.:

My knowledge of this grass is obtained from the cultivation of it for twenty-five years, fifteen of which I grew it for hay in Alabama, where it came into competition with Northern hay and brought the same price. Even those who do not like it in their cultivated fields acknowledge its great value. Because of its rapid growth, it can be cut 3 and 4 times each season, and is earning more money than any hoed crops. Mr. N. B. Moore, a prominent farmer of Georgia, for forty years experimented with various grasses and finally chose this grass as the best of all, and it is still growing on his place near Augusta, the whole farm being given up to it from choice.

Prof. S. A. Hoover, Springfield, Greene County, Mo.:

I look upon it as the most dangerous weed that can enter the State. I believe when it once gets a foothold on a farm it is utterly impossible to get rid of it. It spreads by means of its rootstocks as well as by its seeds. Plowing only helps it to spread by breaking up these rootstocks and scattering the pieces. It is simply impossible to grow any crop with Johnson grass. The immense number and size of its rootstocks prevent the growth or cultivation of other plants with this pest. Hogs will eat the rootstocks, but there are always enough pieces left to start another crop. It grows entirely too coarse for hay in this part of the country. In western Texas, where the rainfall is light and other forage plants do not succeed, it is a good thing to raise for hay, as the land can be completely given up to it. In this State and in Kansas, where much better forage plants may be grown successfully, it seems very foolish to attempt its cultivation. In fact, farmers ought to be on the lookout to destroy every stalk that makes its appearance.

SMOOTH BROME GRASS (*Bromus inermis*).¹

(Plate III.)

The seed of this variety was obtained by the Secretary of Agriculture for the Department through Prof. N. E. Hansen in February, 1898. The lot consisted of 12 tons from the Penza province, in the Volga River region of Russia. At the agricultural school at Uralsk, on the Ural River, where the annual rainfall is 12.6 inches, the smooth brome grass was regarded as the best grass for the steppes. Professor Hansen writes:

The best Russian authorities do not think this grass equal to timothy in feeding value, but it flourishes in sections where timothy is an utter failure. Its chief value will probably be in dry regions.

Smooth brome grass is a vigorous, hardy perennial, with strong, creeping rootstocks, smooth, upright, leafy stems 1 to 4 feet high, and loose, open panicles or "seed heads" 4 to 8 inches long. In a few years it forms a very tough sod, soon crowding out other grasses, clovers, and weeds. Its remarkable drought-resisting qualities have

¹ For full discussions on smooth brome grass see Circular No. 18, Division of Agrostology, U. S. Dept. Agr.; Nebraska Experiment Station Bul. No. 61; South Dakota Experiment Station Bul. No. 45; North Dakota Experiment Station Bul. No. 40.



SMOOTH BROME GRASS (*BROMUS INERMIS*), SHOWING PLAT OF THE GRASS GROWN IN THE UNITED STATES GRASS GARDEN, WASHINGTON, D. C.

From a photograph by F. Lamson-Scribner.

proved it to be a most valuable grass for dry regions where other grasses could hardly exist. It is the most suitable grass yet introduced for the dry regions of the West and Northwest. As it is thoroughly permanent and grows with wonderful rapidity, producing heavy crops of hay and luxuriant pasturage, its value to the farmers of the semiarid regions of this country can not be overestimated. All kinds of stock eat it with relish, and the chemical analyses made show that it is rich in flesh-forming materials, much more so than timothy. It is very hardy, and not injured by severe spring and fall frosts when once established. As it starts to grow very early in the spring, before any of the grasses upon the native prairies show any signs of life, and remains green and succulent far into November, it will supply the long-felt want of early and late fall pastures.

In the spring of 1898, 536 packages of the Russian seed of smooth brome grass were distributed by this Division through the Section of Seed and Plant Introduction. This does not include the State experiment stations, many of which received large consignments directly from the Department. The States receiving the largest amounts of seed were Kansas, Montana, Texas, Colorado, Nebraska, North Dakota, Washington, and Oregon, in the order named. Out of the 536 experimenters receiving the Russian seed of smooth brome grass, 284 have complied with a request from the Division for reports as to its success or failure. From the reports received it is evident that it is little influenced by the changes of climate. It does well in California, Colorado, Indiana, Iowa, Kansas, Montana, Nebraska, North Dakota, Ohio, Oregon, South Dakota, Tennessee, Utah, Washington, and Wyoming. Sufficient experiments have not been carried on in the South to enable us to state here its value for that part of the country. Professor Tracy, of Mississippi, speaks of it thus:

Although its growth on the test plots was all that could be desired, its growth in the field has often been disappointing, and it is not gaining in general favor. * * * After eight years' experience with this grass, on a great variety of soils, it appears to be of doubtful value in the Gulf States. It has here some value for winter grazing on dry and loose soils, but its place can be better filled by other species.

The experiment stations of California, Colorado, Iowa, Kansas, Minnesota, Manitoba, Nebraska, and North and South Dakota have all made extensive experiments with smooth brome and recommend it highly both for hay and pasture, especially for dry and poor soils.

The following reports from volunteer experimenters in the different States prove conclusively the immense value of the smooth brome grass to the farmers of this country:

CALIFORNIA.

Messrs. Guill Brothers, Chico, Butte County:

The seed was drilled in by hand on the 4th of March, 1898, and covered 2 inches deep. The soil is a sandy loam, and had been put into excellent condition by fall

plowing and harrowing with a spring-tooth harrow. The crop was cultivated three times. The vitality of this seed is remarkable; we had no rain to wet the ground for six months—from May to November—yet there was none of the grass that died from drought. The grass made a growth of about 8 inches during the season. During the autumn and early winter it has continued its development and is now in excellent condition.

A plot of this grass was sown broadcast on October 21 and harrowed in and is looking very well at the present time. It has withstood some of our severest winter weather without any ill effects. The food value has not yet been tested, but otherwise it is a remarkable grass.

Mr. P. H. Murphy, Perkins, Sacramento County:

A clay loam soil was used which had been plowed and harrowed. The seed was sown March 1, 1898, and then harrowed in. As the ground was dry, having no late rains, it did not come up. This year (1899) the land where the brome grass was planted in 1898 was flooded and there was a heavy crop. It grows about 3 feet high and looks like chess or cheat which grows in wheat, only the seed is finer. It makes a good hay for cows if cut when in full bloom, but I prefer oats or barley for hay.

COLORADO.

Mr. E. E. T. Hazen, Holyoke, Phillips County:

The seed was sown broadcast April 28, 1898, at the rate of 3 bushels per acre. The soil is a sandy loam of medium quality and fertility and was plowed 10 inches deep and harrowed twice before sowing and once after.

The seed was well up May 13, but when about 4 to 6 inches high Russian thistles appeared among them and in a short time completely overshadowed them. The brome grass then stopped growing in height and formed a perfect carpet-like mat on the ground, retaining its fresh green color until December 1. A few stalks, however, found their way up through the thistles and headed at the height of about 18 or 20 inches.

Mr. Melvin Thompson, Lansing, Arapahoe County:

The seed was sown broadcast on April 4, 1898, and covered by light harrowing. The soil is light, sandy, upland loam, and was plowed, planked, and harrowed until moist and in fine condition. The grass was kept down by "hoppers," but made a fair stand, and at present date, November 6, is in good condition.

Mr. W. W. Lindsay, Gulnare, Las Animas County:

The brome grass came up nicely, making a good stand, but owing to extreme drought, the worst in this section for twenty years, I am afraid most of it is killed. It may come up, however. I think in any ordinary season it would do well here, once it became established, as it starts to grow earlier than even alfalfa, which is our mainstay. It is said to do well in some parts of the State.

Mr. M. McFarland, Villagrove, Saguache County:

A sandy loam was used which had been in cultivation for several years. The seed was sown broadcast in May, 1898, and irrigated immediately after sowing. Shortly afterwards we had a heavy snowstorm. I did not get a good stand and did not harvest last year, as there was not enough growth. I harvested to-day (September 25, 1899), however, with binder to save seed. The yield per acre is probably 200 pounds, the seed being 100 per cent heavier and better than that sown. It withstands droughts remarkably, and is the earliest grass green in the spring and latest in the fall. It will furnish first-class pasturage after cutting for seed, and I think will be valuable to sow in permanent pasture land.

INDIANA.

Mr. Henry Wehry, North Vernon, Jennings County:

The seed was sown March 8, 1898, on ground that had been harrowed twice with a spring-tooth harrow and once with a spike harrow after sowing. The soil is a clay loam, which was sown to oats and Canada field peas in 1897, plowed in October, 1897, and then left to lie over winter in the rough furrow. The grass was damaged considerably by hard frost on April 6 and 7, but did not seem to suffer any from drought. It made about the same growth as orchard grass, but stood dry weather better. The growth was from 6 to 18 inches in height.

IOWA.

Mr. H. J. Giddings, Sabula, Jackson County:

The seed was sown broadcast April 1, 1898, part of it with oats and part without a nurse crop. The soil is a clay loam and was in good tilth, having been plowed and well harrowed. The grass was all up nicely on May 1. It has not produced a crop yet, but at present it covers the ground with a growth about 3 inches high. A very severe drought during the growing season killed nearly all of the timothy and clover sown in the spring; but the brome grass stood it better than either of them and is better on the oats stubble than where it was sown without a crop. All young clover and timothy were winterkilled, but the brome grass was not injured a particle. It commenced to grow very early this spring, and was green before anything else. As it produces a large amount of aftermath, it seems to me that it will be better for pasture than for hay, especially for waste places and land not easily cultivated.

Mr. E. L. Hayden, Oakville, Louisa County:

The seed was sown on clay loam about the 1st of April, 1898. It was cut for hay about the last of June when just out of bloom. The quality of the hay was good, but it will not take the place of timothy in this part of the country.

Mr. I. W. Hoffman, Roselle, Carroll County:

The seed was sown broadcast in May, 1898, on a sandy loam. This grass seems very promising for this part of the country. It possesses several good points, such as resisting drought and not winterkilling. It forms a thick, luxuriant growth and is very well liked by all kinds of stock. It is a strong grower, very dense and stocky, and seems to be valuable here for both hay and pasture.

Mr. S. H. Talley, Packwood, Jefferson County:

The seed was sown broadcast by hand April 11, 1898. The soil was a light clay loam which had been rolled and thoroughly disked. After sowing it was redisked and harrowed smooth. The brome grass was sown with clover and grew well, forming a good sod, and now, November 22, the brome has the field. The weeds were mowed off about July 20. I think it will prove good for pasture, and will stand much trampling.

Mr. J. H. Talley, Packwood, Jefferson County:

The quality of brome grass is good, but not quite equal to red clover. It makes an excellent growth, remaining green all winter where protected. It is a very gross feeder, making a very stiff sod, and a splendid grass for permanent pasture. I highly recommend it where it is too dry for timothy.

KANSAS.

Mr. A. T. Bentley, Wallace, Wallace County:

The seed was sown March 9, 1898, on a clay soil which had been plowed deep and thoroughly rolled. It made a good growth in spite of the grasshoppers, but not sufficient to harvest.

Mr. Clark Bell, Burlington, Coffey County:

The seed was sown broadcast April 25, 1898, on a limestone prairie. The land was plowed in September, 1897, harrowed, then dragged with a plank drag, and harrowed again after sowing. The seed came up in a few days, looked thrifty, and made a good stand; but, owing to the very wet spring and summer, the crab grass came so fast that it was necessary to mow the field, which retarded the growth of the brome grass. However, at this writing the brome grass looks well, and I am quite well satisfied with it. It starts very early in the spring and continues green until late in the fall. At this date—October 24, 1899—it is the only grass in the pasture that is green, and the stock eats it well.

Mr. Benj. Brown, Natoma, Osborne County:

The seed was sown broadcast April 10, 1898, on well-prepared, rich, prairie-bottom soil. I secured a fine, strong stand, but the most of it was killed by drought in the latter part of 1898. Most of that on the low land lived and made a strong growth in 1899. I think it may be a valuable grass, but not on the dry uplands. It seems to be better adapted here for pasture than hay. The leaves are large, dark green, and succulent. Stock is fond of it.

Mr. W. C. Hollewell, Barnes, Washington County :

A black loamy soil, plowed early, as soon as frost was well out of the ground, and harrowed thoroughly. The seed was sown broadcast on March 20, 1898, and covered by harrowing. The grass grew to be about 2 feet high, with an undergrowth of from 8 to 12 inches. It remains green until hard freezing. I think it is a grand success for this country.

Mr. George James, Concordia, Cloud County :

The seed was sown April 22, 1898, part with press drill and the remainder broadcast. All came up at the same time. The soil is black prairie, in a small flat hollow, but not low or wet. The dry weather set in about July 1 and lasted until September 9, when we had a rain that wet the ground 2 inches deep. The grass had seemed to be dried out, but it came up and is now 6 inches high, although the stand is not as good as when first started in spring. I cut one-fourth of an acre of it with a harvester and got 3 bushels of seed which is better than that received from you. I believe that it will make a good pasture. It gets ripe and dies down in July, but springs up again in September. If there is any moisture it will grow as quickly as clover. I intend sowing 3 acres for pasture on low ground next year, and I believe it will be all right where the ground will grow a good crop of clover.

Mr. S. P. Langley, Morland, Graham County :

The seed was sown broadcast about May 10, 1898, and lightly harrowed. The soil is a very moist, sandy loam, and had been plowed with a common stirring plow. The weeds were mown from among the grass about June 15. The grass grew very slowly, but formed a very compact sod. Frost had little effect on it, and it afforded good pasture.

Mr. M. Olson, Mullinville, Kiowa County:

The soil was a black sandy loam, which had been plowed and harrowed. The seed was drilled in about the middle of May with a press drill. It came up very

well, but as it was wet in the spring the weeds got ahead of it. After this we had a dry spell which dried it out so that there was nothing left to harvest.

Mr. T. E. Pearce, Edgerton, Johnson County:

The land used was high prairie soil on the bluff of a creek, part of which is underlaid closely with rock. The soil was deeply plowed, disked, and harrowed down fine. The seed was sown broadcast on April 19, 1898, and then harrowed in lightly, the ground being in a very moist condition. I thought it had died out in the fall, and so reported to you, because wild grass had completely covered it up. In the spring of 1899, however, it awoke like a sleeping giant and covered the ground with dense foliage, 1 foot high. It did not produce much seed, but proved to be an excellent pasture grass. The grass does not get tough, like most grasses do, and is very tender to eat. The green growth starts very early in the spring, and I think, from what I have seen of it so far, that it will be a fine pasture and hay grass.

Mr. George Strickland, Russell Springs, Logan County:

The seed was sown broadcast on April 1, 1898, on one acre of land. It came up nicely, but not quite as thick as I would have liked. This spring it has started, and looks very well, although the grasshoppers were very destructive to it in the fall.

MARYLAND.

Mr. John C. Bartlett, Easton, Talbot County:

The seed was sown by hand in April, 1898, on a clay loam that had been prepared by being plowed, harrowed, and rolled. The seed, after being sown, was rolled in. The ground had been manured in the fall with stable manure. The grass came up well and now looks about like lawn grass.

Mr. John C. Talbot, Easton, Talbot County:

The seed was sown broadcast in April, on good, well-prepared clay loam, in an apple orchard which is used as hog pasture. It looks now about like orchard grass, but does not stool or go to seed. It went through last winter all right.

MICHIGAN.

Mr. H. W. Crawford, Sitka, Newaygo County:

A clay loam prepared as for potatoes, and sown with the brome seed about June 10, 1898. Solid stools of roots were produced from 4 to 6 inches across. It has wintered all right, and I shall watch its growth with interest. I think that it will make a good pasture grass, and is worthy of a thorough test.

MINNESOTA.

Mr. S. M. Warman, Sandstone, Pine County:

The seed was drilled in May 16, 1898, in sandy upland soil. The grass ripened in September, after surpassing all imagination. The quality of the product was perfect. It is splendid grass for us, the hay being worth about \$7 per ton.

MONTANA.

Mr. E. Beach, Augusta, Lewis and Clarke County:

A dry, gravelly, bench land was used. The seed was sown broadcast on May 5, 1898. The grass was cut for hay about July 20. The quality of the product was good, yielding about 1 ton per acre; and if it continues as at present, it will be a very good grass for dry climates, both for pasture and for hay. It seems to contain more nutriment for stock than alfalfa or esparcette, and they eat it more readily.

Mr. William Flannery, Bozeman, Gallatin County :

A sandy loam, excellent for almost any kind of crop, which had been well cultivated by plow, disk, and harrow, was used. The seed was sown June 17, 1899, partly in drills and partly broadcast, then harrowed and rolled. The crop was irrigated twice. The grass came up, and is now in a thriving condition. As it was planted late and is a perennial, I shall not be able to form an opinion of its value until it has wintered and grown another year.

William W. Gamble & Son, Choteau, Teton County :

A gravelly, bench-land loam, which had been irrigated, well plowed, and harrowed, was used. The seed was sown May 19, 1898. The quality of the product is good. The grass starts early in spring and grows rapidly and continuously through all sorts of weather—warm or cold, wet or dry—without apparently being much affected by climatic conditions until maturity. With us it did not make much of a fall growth. Its probable value is considerable, although just how much we have not seen enough of the plant to determine to our satisfaction.

Mr. Paris Gibson, Great Falls, Cascade County :

The seed should be sown in April on well-pulverized soil, and much care should be used in brushing or harrowing it in. Ordinary preparation of soil is required. While it will thrive better on rich soil, it makes a remarkable growth on sterile lands. My field has produced large crops for three years with no cultivation. To make good, tender hay in Montana it should be harvested in June, or as soon as it heads. It is in full bloom by the middle of June. If ground is properly seeded it will yield from 2 to 2½ tons per acre. I believe it will be a most valuable hay crop for Montana, as it is a persistent grower, comes up very early in the spring, and does not kill out easily. I think two crops can be gathered in most seasons.

Mr. W. H. Heidman, Kalispell, Flat Head County :

The grass was sown broadcast April 23, 1897, 1 pound of seed to one-fourth of an acre. The soil, a sandy loam, had been sown in oats the previous year and was harrowed before sowing, and harrowed lightly and rolled after sowing. About the 10th of July the crop was cut, as the weeds were very bad. The grass made a good growth and was in bloom June 28, 1898, ripening August 1. If cut for hay, it would make about 1 ton to the acre. This grass is eaten greedily by the horses; cattle and hogs like it. The seed germinates as quickly as oats. It came out green this spring and commenced to grow while it was yet quite cold, making good pasturage long before any other grass started. We have had no rain since the middle of June, but it keeps green, and looks fresh and healthy.

Mr. Len. Lewis, Lewis, Meagher County :

A limestone soil on dry, bench land was used. The crop was well irrigated. I secured a heavy yield. The grass grew rapidly and produced a very luxuriant growth. I think it will be a very valuable grass. I sowed 7 acres more this year and expect to put in about 50 acres next year.

Mr. T. P. McDonald, Red Lodge, Carbon County :

The seed was sown on June 14, 1898, on plowed sod that had been disked 4 times. After sowing the ground was harrowed both ways. The upper end of the piece was irrigated once. I find it to be a strong grower and believe it to be a fine pasture grass. I think it is adapted to a dry climate. It was green until winter. It proved to be the best pasture grass we have found for dry lands and did better where it was not irrigated at an elevation of 5,800 feet.

Mr. Emory Vine, Miles City, Custer County:

The seed should be sown about March 26; then harrowed and irrigated after sowing. The soil, a gumbo clay loam, was plowed and harrowed in the usual way before seeding. When used for hay it should be harvested about 20th to 25th of June and for seed about 1st of August. It blooms about the 20th to 25th of June and ripens about August 1. The quality of product is good, and stock eat it readily. There is much to be learned about this grass. It will surely make a crop with less moisture than any other grass.

Mr. C. H. Williams, Deer Lodge, Deer Lodge County:

A sandy soil of granite formation was plowed 4 inches deep. The seed was sown broadcast on May 15, 1898, and covered lightly with a harrow and irrigated once. It is good for pasture and succeeds well on dry soil. It will probably be useful to reclaim ranges, but the yield is too light to be profitable for hay.

Mr. C. C. Willis, Plains, Missoula County:

The seed was sown May 4, 1898, on land plowed April 15, and harrowed fine. After sowing the land was thoroughly harrowed and rolled. The soil, which was a sandy loam underlaid with clay, had formerly been planted with bunch grass. Seeds formed in the heads about August 1 and ripened August 15. The yield is about 1½ tons per acre. The grass will do well on our bench lands if properly put in. It seems to stand dry weather well and grew from 18 inches to 2 feet high.

NEBRASKA.

Mr. H. S. Chapman, Pawnee City, Pawnee County:

A rich black loam was plowed and pulverized and sown with a drill on May 20, 1898. A thick mat of grass blades appear very early in the spring. It is a good pasture grass, but worthless for hay, as it is a low blady grass. It throws out a slender seed stalk about 14 inches high and produces an abundance of seed.

Mr. W. S. Delano, Lee Park, Custer County:

The seed was sown broadcast on May 14, 1898, and covered by light harrowing. One-third of the seed was sown with barley. The ground had been plowed in spring and cultivated with a harrow. The field was clipped with a mower except where sown with barley. The grass planted in barley was almost a total failure. It made a very good stand where sown alone, but the growth was light on account of drought. The brome-grass was pastured in spring of 1899, and then later a crop of hay was mowed July 10. After this cutting it top dried and died down. In October it started again from the crown, and at this date (October 31) it is 3 inches high. It is an excellent pasture grass, starting earlier in the spring than alfalfa, and thickens into a solid turf. All stock like it, and it promises to be an excellent grass for this section.

Mr. C. H. Searle, Edgar, Clay County:

The seed was sown broadcast about the end of April, 1898, on well-prepared black, loamy soil. The weather was very dry in July and August, and I was afraid that the grass was dead. However, it came out all right this spring very early, but did not make a heavy growth.

Mr. A. Shirley, Weeping Water, Cass County:

The grass was sown broadcast May 1, 1898, on black loam bottom land that had been plowed and harrowed till smooth. The tops of the weeds were clipped May 20. When harvested September 20 the grass was 18 inches high. About 1½ tons of hay per acre are produced of extra good quality. I consider it one of the best grasses for hay and pasture ever introduced into this neighborhood. It stands drought well.

Mr. J. W. Williams, Weeping Water, Cass County:

The seed was sown broadcast April 5, 1898, shortly after a rain and well harrowed in. The soil, a black loam, part well drained and part very low and wet, had been plowed 6 to 8 inches deep and well harrowed before sowing. On June 20 the weeds were taken off with mower. The grass made a very good growth and will be, I think, a good pasture grass.

NEW MEXICO.**Mr. James B. Horn, Cliff, Grant County:**

The seed was sown broadcast on a gravelly soil June 1, 1899, and harrowed in. It does very well in low places and makes good pasturage or hay.

Mr. James K. Metcalfe, Silver City, Grant County:

The seed was sown broadcast on a high gravelly ridge early in May, 1898, and irrigated. It grew this and last summer, but only an occasional seed stalk was sent up. It looks as if it would be a very good pasture grass, but very thin, a few bunches seeding here and there at a time.

NORTH CAROLINA.**Mr. P. S. Early, Mocksville, Davie County:**

A black loamy soil was used. The seed was sown May 10, 1899, and harrowed in. Just as the seed began to come up a hard frost came. I was very highly pleased with the start the grass made, and I believe had no frost come the result would have been fine. The land was moist and very rich.

Mr. J. S. Holmes, Bowmans Bluff, Henderson County:

A fairly good upland clay loam was used, which had been plowed with a one-horse plow and harrowed twice with a Thomas smoothing harrow. I sowed one acre at the rate of 31 pounds per acre on May 12, 1899, and covered once with a smoothing harrow. There was a fairly good stand, though hardly as good as some orchard grass higher up on the hill. The ground was badly washed by a heavy storm, but it looks now as if it would stand the winter all right.

NORTH DAKOTA.**Mr. Wm. Brittin, Sterling, Burleigh County:**

A sandy soil was plowed and harrowed twice. The ground was well pulverized, but it was too dry for seed to germinate readily. The seed was sown broadcast May 12, 1899, at the rate of 2 bushels per acre. The grass made a good growth, but did not send up any seed stems. It rained May 17 and 21. The seed came up May 24, and held its own through a very dry season, and is still green November 1. I think it will succeed in this part of the country.

Mr. F. A. Eaton, Medora, Billings County:

A sandy soil was plowed and harrowed well and the seed sown broadcast on May 20, 1898. We think this will be a good grass for us, and next year will put in a large field of it.

Mr. N. S. French, Grand Rapids, La Moure County:

An upland prairie, that has been under cultivation about nine years, was plowed about May 4, 1898, and harrowed into good condition. The seed was sown with barley at the rate of about 70 pounds of barley and about 9 pounds grass seed per acre. I cut

the barley about August 3, 1898. The brome seed was cut with a header about July 10, 1899. It is first class in all respects. Its growth and feeding qualities are such as will make it of incalculable value to this locality and climate. I have raised and cut forage crops for nearly forty years in 4 or 5 States, and I have never seen anything that seems to promise as much for any locality as this does for the Northwest. It is excellent for pasturage, so far as I can judge at this time.

Mr. W. Hanson, Englevale, Ransom County :

The seed was sown broadcast May 20, 1898, on clay loam that was plowed last fall. One-half was harrowed last fall and all was well harrowed this spring, making a very fine seed bed. The weeds were kept mowed down on three-fourths of the plot; the rest was sown with oats. I have a fine catch that bids fair to make a good growth next year. It is very green this fall, while all other grasses are dead and dry.

Mr. J. W. Higgs, Silver Leaf, Dickey County :

The seed was sown about April 18, 1898, on an upland field that had been in potatoes the season before and was in fine shape for grass. It made a good stand, but dry weather in July killed a good portion of it. This season, 1899, it was very thin, so I let it go to seed, then mowed it and left it on the ground. I think it will be thick enough next year. We have much trouble in this section to get a good stand. This is a fine grass, and I think it would yield enormously if one could secure a good stand. It grows about 3 feet high and is about the same as the brome grasses we have been growing here, which I think is our main grass. I want to put in 200 acres as soon as I can.

Mr. Chas. Kunth, Hebron, Morton County :

I gave out the seed in 1898 to about a dozen farmers, who planted it in different soils, and in every case it has been a success. Farmers have bought seed and planted many acres to it. Brome grass is considered the future forage plant in this section.

Col. W. W. McIlvain, Lisbon, Ransom County :

The soil was plowed 7 inches deep and subpacked. The seed was sown April 15, 1899, with wheat, or rather, on same ground after the wheat had been sown. The wheat was harvested the last of July, and there was a good undergrowth of grass 4 to 6 inches high. I have grown this grass on the grounds of the Soldiers' Home for three years very successfully, cutting two crops, one on June 1 and another September 1.

Mr. H. S. Nichols, Oakes, Dickey County :

A black sandy loam was plowed deep and manured. The seed was sown broadcast about April 15, 1898, without a nurse crop. The growth was thrifty and I should estimate the yield at 2 tons per acre had it been cut for hay. I am well pleased with it and believe that it is a very valuable grass. It seems to be a decided success in this locality, as it makes a good firm sod and starts earlier in the spring by two weeks than any other vegetation.

Mr. J. B. Power, Power, Richland County :

The seed was sown by hand about May 10, 1898, on poor sandy soil, which had been in wheat the year before. Nothing whatever shows now (October 19), but as this is said to be the normal condition of brome grass the first year, it will undoubtedly show up well next spring. We had similar results four years ago, but plowed up the land in the fall after seeing no growth, but have since had good growth along the edge of the same field. I believe it to be an excellent grass.

Mr. B. S. Russell, Jamestown, Stutsman County :

A black sandy loam was used, which had been prepared for cereals. Part of the seed was sown with oats as a nurse crop from April 15 to August 1, 1898. Where

sown with a nurse crop it did not grow until the nurse crop was harvested, then it grew well. It yields about 2 to 2½ tons per acre. In quality it is very good where pastured, cattle going long distances to find it. It is well established as the grass for North Dakota. It takes kindly to the soil and is the earliest grass in the spring, even earlier than the bunch or buffalo grass, and is green in the autumn when the wild prairie grass is brown. It has been sown by many farmers this year in small parcels from 5 to 40 pounds, and will be increased by all next year.

OHIO.

Mr. J. E. Wing, Mechanicsburg, Champaign County:

A white-oak clay soil was slightly manured, plowed, and well prepared. The seed was sown with alfalfa May 20, 1898. It looks very thrifty and promising, with a dense leafy undergrowth. I expect it to be of great value to use with alfalfa.

OREGON.

Capt. Joseph Dawson, Bay City, Tillamook County:

A black sandy loam was well manured, plowed 6 inches deep, and rough harrowed once. The seed was sown May 4, 1898, by first sowing oats, harrowing once and then sowing the brome grass broadcast on the same ground. The land was then cross-harrowed and the ground smoothed with a clod-masher, and let alone to grow till harvest time. On August 20, 1898, I secured a heavy crop of grass. It matured as much as the seedsmen claim it will do the first year. I kept the live stock off of it for fear they would tear or tramp it out during the rainy season. When our heavy fogs came inland it died down to the ground. In February, 1899, we had frost 10° above zero. When harvest time came I could not see a single head of it. Since the fall rain has come it has sprouted again. The longest stem I could find was 10 inches high. The present status agrees with all I have read about, namely, not much growth the first year, but will mature the second year.

Mr. W. A. Wintermeier, Silvies, Harney County:

A decayed lava and clay soil was used. The ground was plowed 10 inches deep, leveled off and harrowed, and the seed sown the 1st of May. After sowing, the ground was harrowed again and rolled. The grass grew from 3 to 12 inches high, forming a good thick stand. It does not grow very tall, but forms a heavy sod. We have had some very cold weather, but the grass is still green.

SOUTH DAKOTA.

Mr. H. C. Bockoven, Clark, Clark County:

The seed was sown broadcast on April 10, 1898, and harrowed in. The soil was a black loam in good condition and was plowed and harrowed. The grass bloomed June 25, was ripe July 15, and was harvested on the latter date. The quality of the product was good, and it seems to be a valuable grass for a dry climate. It grows well and stands the dry weather better than most other grasses. It has a large amount of leaf growth at the bottom, making it valuable for pasture as well as hay.

Mr. W. H. H. Phillips, Brookings, Brookings County:

A black loamy soil was plowed in the fall of 1897, well harrowed, and the brome seed sown by hand about April 17, 1898. It was cut the last week in July with the binder for seed. There would have been probably from 1½ to 2 tons of fine hay. It covered the ground well in August, 1898, and was green until December. It is a very promising grass. I shall distribute some seed to a few good farmers and sow the rest on my land in 1900.

Mr. D. Roberts, Faulkton, Faulk County:

The seed was sown broadcast April 1, 1895, and April 10, 1898, with one-half bushel of spring rye, and lightly harrowed in and rolled. The land was dark prairie soil that had been cultivated ten years. It was manured lightly three years ago with barnyard manure. The ground was well prepared and the seed sown early in the spring. The grass bloomed July 15 and ripened from August 1 to 10. It was cut for seed about August 1 to 10, then followed with a mower for hay. It was well seeded and matured. The grass is a very strong grower, with thick, leafy bottom from 12 to 16 inches high, and seed stalks running up 12 to 14 inches higher are well loaded with seed. Stock is fond of it, and it has every appearance of making hay equal to or better than timothy.

Mr. A. B. Smedley, Millbank, Grant County:

The seed was sown in spring of 1898 with wheat as early as the ground could be worked. I harvested July 15, when fairly headed, and cut for hay before ripening. It produced 2 tons of hay per acre of excellent quality. As hay is never sold from my farm I can not say of what value it is, but for feeding it is fully equal to timothy or clover.

Mr. E. T. Stevens, Woonsocket, Sanborn County:

I sowed some of the seed with spring wheat and oats after the grain was in and did not harrow it; it did not grow. The rest was sown alone on ground that had been well prepared and cultivated; it was fine. I saved the seed, and will sow again next spring. This spring, April, 1899, I sowed one-half acre of old ground and dragged it thoroughly; the grass came up nicely. This spring it was two weeks ahead of any other grass to start into growth. I saved the seed on the 1st of August. The plants were about 30 inches high, with a very thick undergrowth; the product is excellent. One of my neighbors east of me has 10 acres that is immense; it is on shady ground, while mine is on high land. I think it is just the kind of grass that we want for this country.

Hon. H. C. Warner, Forestburg, Sanborn County:

Five different methods were adopted in planting the seed:

Experiment 1. A field of river-bottom land was used. The seed was sown on the unbroken sod, then the land was thoroughly harrowed. This gave 30 per cent of a stand.

Experiment 2. A dry upland pasture was used and the land was pulverized and harrowed before sowing. This gave 5 per cent of a stand.

Experiment 3. A dry upland pasture that had been pastured for sixteen years was used. The land was pulverized both ways and the seed sown and harrowed in. It came up well, but the young plants were exterminated by a drought of four months.

Experiment 4. The land, which had been cultivated for some time, was plowed and well prepared; the brome seed was sown with oats as a nurse crop. This gave 95 per cent of a stand.

Experiment 5. The land was plowed and well prepared as in the preceding instance; the brome seed was sown with wheat as a nurse crop. This gave a perfect stand, and is this season a perfect meadow.

The brome grass will stand cold and drought without killing after the first year. Wheat is better than oats for a nurse crop. On sod a better stand can be secured by sowing the seed first and then pulverizing it in. It is a perfect hay or pasture grass for the Northwest.

TENNESSEE.

Mr. H. G. Dail, Dutch Valley, Anderson County:

A light soil with clay subsoil was used that would produce 20 bushels of corn per acre. The land was plowed and disked, then dragged and worked fine. The seed

was sown broadcast about May 15, 1898, and brushed in. I did not harvest any except to give some to the stock. They ate it with relish. It is rather coarse in quality. I think this grass will be good for pasture, as it seems to stool like orchard grass or oat grass. It is thin on the ground and has not yet made turf. I think, from what I know of it, it will be best for pasture, as it bunches on the ground and is now (October 18, 1899) 7 or 8 inches high.

Mr. Paul F. Kefauver, Madisonville, Monroe County:

A heavy, clay, fertile loam was used. On February 19, 1898, 35 pounds of seed were mixed with 150 pounds of complete fertilizer and drilled in with common wheat drills. The season was good and the grass made a good stand, although not so good as either the redbud and timothy or the orchard grass plats adjoining, which were sown April 12 and March 1, respectively.

TEXAS.

Mr. G. A. Graham, Graham, Young County:

A black, sandy soil with a red clay marly subsoil was used, which had been thoroughly plowed and harrowed. The seed was sown September 25, 1899, after a slight shower and raked in by hand. A heavy rain fell October 26, when the seed commenced coming up. It is now 3 or 4 inches high. We have had two frosts, and it has received no injury. I am pleased with its appearance and growth.

UTAH.

Mr. James Lofthouse, Paradise, Cache County:

The seed was sown broadcast April 25, 1898, and harrowed in on a dry, rather poor, loamy upland or bench land that had been plowed the previous fall and disked in the spring. The grass was not harvested, as it did not grow high enough. I think it will be very valuable, as it looks nice and green now (November 21).

Mr. Samuel Roskelley, Logan, Cache County:

The seed was sown broadcast by hand April 30, 1898, and harrowed in with a light harrow. The soil was strong sage-brush upland that had been well plowed last fall and replowed in the spring, and thoroughly harrowed. The seed came up nicely without further cultivation. The grass bloomed July 27. It headed out nicely, but did not fully mature on account of drought. I regard it as an excellent drought-resisting forage plant.

WASHINGTON.

Mr. Frank Bacon, Rockford, Spokane County:

The seed was sown on white-clay hilly land that was too poor for spring wheat. It was sown April 12, 1898. The ground was plowed twice and harrowed down fine the summer of 1897, and by rebreaking was in fine condition for sowing. After passing through severe droughts, such as are common here, the grass made a good stand and remarkable growth, and I, as well as my neighbors and all who have seen it, regard it as valuable for this dry, arid country. It is now (October 20, 1899) a beautiful sight. It keeps green and its value for nice pasturage can not be overestimated. The brome grass will not be used for hay, but through the long, dusty, frightful droughts it will be of great value for pasture.

Mr. F. A. English, Farmington, Whitman County:

The seed was sown broadcast by hand April 12, 1898, and dragged over with flat-tened heel harrow. The soil had been plowed and harrowed thoroughly in the early

spring, about a week before planting. The grass was cut in August to increase root development. The growth is fine and will make a record during the coming year. This plat was sown in the poorest land on the farm—high, dry hill land, gravelly and unfit for any other crop. The season was the driest and hottest during twenty years, there being no rainfall during July, August, and half of September. The grass should be planted extensively. I have a number one stand for next year, and I am satisfied that it will make a fine crop of hay and also good late pasture. I can recommend *Bromus inermis* as a truly wonderful plant for dry climates, producing fine hay and pasturage.

Mr. W. E. Lawrence, Toppenish, Yakima County:

New bottom land was plowed 8 inches deep, then the seed was sown, harrowed in, and rolled hard. At this date (October 2) it is getting thicker and furnishes more pasture than any other grass grown here.

Prof. W. J. Spillman, State Experiment station, Pullman, Whitman County:

The seed was sown on clay loam upland, 2,500 feet altitude, in good tilth. Three years' experience indicates that this is the best grass for meadow and pasture for the uplands of eastern Washington. I pastured 1.9 head of cows per day from May 13 to September 1, 1897, on one acre of this grass. Horses especially relish hay made from it.

Mr. Nelson Williams, Chewelah, Stevens County:

The seed was sown broadcast May 2, 1898, on a sandy loam and harrowed in. The land was comparatively new, at one time covered with timber, and was plowed and harrowed before seeding. The grass was not cut, as it did not grow tall enough. The growth was very slow, but there appears to be a good stand.

WISCONSIN.

Mr. J. F. Jensen, Waupaca, Waupaca County:

The seed was sown broadcast on April 25, 1898, with a hand seeder and covered with a light harrow. It was sown with oats as a nurse crop. The soil is clay loam, and was fall plowed and well cultivated in spring before sowing. The grass made a fair growth in the oats, although the season was a dry one. In 1899 the yield per acre was about $1\frac{1}{2}$ tons of hay of good quality, even better than timothy. I think this grass very valuable, especially for pasture, as it will make quite a growth very early in the spring, before even timothy starts. It also grows very late in the fall and forms a very thick sod.

WYOMING.

Mr. John Baugh, Carlile, Crook County:

The seed was sown early in 1898. The whole season was so dry that it did little more than come through the ground, and what few plants came up were too enfeebled to do much. I have a small piece of the same grass in a favored place that gets well wet in the spring. It yields a heavy crop each year.

Mr. G. A. Bell, Hyattville, Bighorn County:

The soil is a dark, sandy, river-bottom loam which had been in cultivation for three years. One year ago it was manured heavily. The land had been plowed 8 inches deep. The seed was sown broadcast on April 10, 1898. The grass stands

frost well, but requires a little more irrigating than timothy. I think it will make a better fall pasture than timothy. It was cut for seed August 15, 1898. I consider this a valuable grass, as it will stand any amount of dry weather and not die out, and will start growing as soon as irrigated. It grows tall, does not lodge easily, and makes very good early pasture in the spring.

Mr. Kirk Dyer, Little Medicine, Albany County:

The seed was sown April 20, 1898, after spring wheat and harrowed in. The soil is clayey loam that has been in cultivation several years. It was highly fertilized with barnyard manure and in excellent condition. The wheat was cut September 1, and there was a nice, thick stand of *Bromus inermis* probably 6 to 10 inches high. The experiment is encouraging and the progress of the crop fully equal to timothy the first year.

Mr. W. R. Williams, Tensleep, Bighorn County:

The seed was sown May 20, 1898, on ground plowed 5 inches deep, leveled nicely, and the seed covered with a harrow. The soil is red gypsum with a deep subsoil and was in good condition. The grass was irrigated three times. I got a good stand, but can not tell much about the value of the grass the first year.

RESCUE GRASS (*Bromus unioloides*.)

An erect, strong-growing annual or perennial grass, 1 to 3 feet high, with numerous long, tender, broad leaves, usually spreading panicles and large, much flattened, drooping spikelets. It is known also as Schrader's brome, Australian oats, Australian brome, and Arctic grass, and is a native of South America and the southwestern portion of the United States. As a rule rescue grass dies the first year after seeding, but if it is grazed closely and not allowed to go to seed it may be used as pasture for two or three years. During the dry summer weather the tips of the leaves turn yellow, but this does not injure the mass of foliage, which remains green and produces fine forage. There are now several forms of this species which vary according to the height of the plant, breadth of the leaves, and the abundance of seed produced on the panicle. In the grass garden of the United States Department of Agriculture, Washington, D. C., rescue grass produces excellent pasturage throughout the summer and fall. It seems to be perennial here, as several plats that have been growing in the garden for several years continue to produce an abundance of dense pasturage every season. The leaves are slightly injured by frosts in early spring and fall. A second growth of 6 inches or more comes up about August 4, after the hay has been cut.

In California it is considered one of the best and most useful grasses for dry lands, being the earliest and best winter-growing grass. As it makes its chief growth during the colder months of the year, it has come to be regarded as one of the best winter grasses for the South. The seed may be sown in August or September at the rate of from 30 to 40 pounds to an acre.

Forty-eight packages of rescue grass have been distributed since 1896, and 10 experimenters have reported, recording four failures, one unsatisfactory, one excellent, and four good results.

The following are some of the reports that have been received:

Messrs. W. Atlee Burpee & Co., Doylestown, Bucks County, Pa.:

A rich, loamy soil was plowed, harrowed, and hand ranked. The seed was sown in shallow drills on May 4, 1898. The stand was good and left until the following season, the tops being removed, but its height not ascertained. On September 22 there was a good stand and fine growth, with quite a good lot of seed heads. At this time (November) it seems to be identical with *Bromus schraderi*, and has made a much stronger growth than the sample of *Bromus breviaristatus* sent us.

Mr. H. T. Fuchs, Tiger Mill, Burnet County, Tex.:

The land was plowed once and the seed sown at different times throughout the year. The seed sown in the fall after the first rain, about October or November, did the best. It grew much better on cultivated land than I ever saw it grow before. In its native state here it comes up in the fall and grows all winter, then goes to seed in May or April, and as soon as the seed ripens and drops, the grass dies. The crop of rescue grass was cut while the sun was very hot, and it cured in one day. As it is never all in full bloom at one time, but flowers gradually head after head, it is difficult to set the best time for cutting. If well cured it is liked very much by horses, cattle, and other stock. This grass is quite valuable, especially because it is hardly ever injured by frost, and comes up where nothing else is growing. It makes a splendid range for hogs and other stock during the winter. Poultry are also fond of it in winter.

SHORT-AWNED BROME GRASS (*Bromus breviaristatus*).

An erect, robust, native grass, 2 to 4 feet high, with numerous large leaves and long, closely appressed branches to the panicle. In Wyoming and Montana it occurs in the open woods among the mountains, where it sometimes forms meadow-like tracts of considerable extent at an altitude of from 5,000 to 8,000 feet. It has been introduced and grown for a number of years in central and western Iowa, where, under favorable conditions, two crops may be cut in a single season. In Colorado it is found to be valuable in the native meadows at an altitude of from 6,000 to 9,500 feet. Short-awned brome grass produces an abundance of leaves, which are well liked by stock. Although not so valuable as the smooth brome grass, yet it is worthy of being extensively tried, especially in meadows at high altitudes. Its cultivation has been carried on to some extent in the Northwest, with very promising results.

In the grass garden of the Department of Agriculture, Washington, D. C., this grass makes a very promising growth. As early as March 28 there is a nice even growth from 4 to 6 inches high. In June, when about 1½ feet high, it blooms, and after being cut produces a dense, vigorous, leafy growth, 1½ feet high, which is not affected by the dry, summer weather, and continues to afford good pasture along into November and December without being injured by frosts.

Twenty-eight packages of the seed of short-awned brome grass were distributed in the spring of 1899. It is, as yet, too early to receive reports from the experimenters. Two, however, have been received, recording very promising results.

Mr. Thomas Ashcroft, Ashcroft, Harding County, S. Dak.:

A loamy soil was plowed and harrowed. The seed was sown with a few oats about the end of May, 1899. The oats were cut in September, but the grass was not high enough to add anything to the bulk of the hay, although it was nice and bunchy. I was well pleased with it.

Prof. D. A. Saunders, Brookings, S. Dak.:

The seed was sown in drills in April, 1899. Only a few rows were planted. It made a good growth and stood the drought perfectly.

SIDE OATS GRAMA (*Bouteloua curtipendula*).

(Plate IV, fig. 1.)

A tall, stout-stemmed, tufted native grass, 1 to 3 feet high, with tough, perennial, fibrous roots and long pointed leaves. The inflorescence consists of a number of short reflexed spikes which are arranged along the upper portion of the stem. Its range extends from New Jersey westward to the Rocky Mountains and southward, through Texas, into Mexico. Where abundant, it is said to make good hay and pasture which is readily eaten by stock. Side oats grama has not yet been extensively introduced into cultivation. In the grass garden of the Department of Agriculture, Washington, D. C., this grass made a luxuriant growth all through the dry summer weather of 1899, producing excellent hay. An aftermath 7 inches high, of fair quality for pasturage, was produced, which was not injured until severe frosts on November 28, when the leaves all dried up. Our special agent at Walla Walla, Wash., reports that it has done well there, producing an abundance of seed, and that it is quite as valuable as the blue grama. In the hills of central and western Iowa and parts of Nebraska it is highly valued by farmers for hay, as it cures readily, and even when cut late in the season the leaves retain their freshness longer than many of the other wild grasses in those regions. The growth of this grass should be encouraged, as it will withstand long periods of drought, and is so deeply rooted that it is not easily injured by grazing. Since 1896, 71 packages of the seed of side oats grama have been distributed and 19 reports have been received from the experimenters. This large difference between the number of packages distributed is due to the fact that 60 of these were sent out in 1896, when no report blanks were sent out and no requests made for a report on the trials. Out of the 19 reports received 3 were failures, 7 unsatisfactory, and 9 good. The following are the most favorable reports that have been received:



FIG. 1.—SIDE OATS GRAMA, GRASS GARDEN, WASHINGTON, D. C.

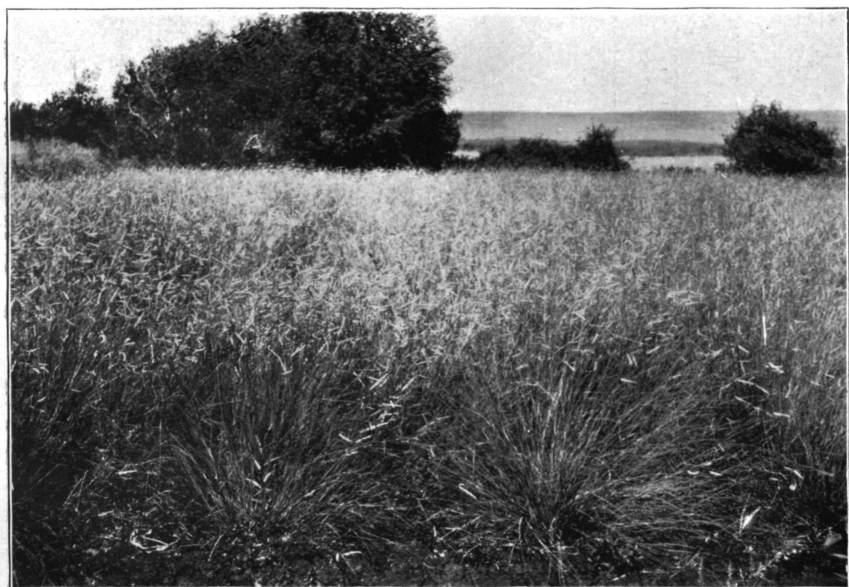


FIG. 2.—BLUE GRAMA (*BOUTELOUA OLIGOSTACHYA*) AS GROWN IN GRASS STATION AT WALLA WALLA, WASH.

From a photograph by A. B. Leckenby.

Mr. G. W. Covey, Laddonia, Audrian County, Mo.:

The seed was sown in an old orchard where the hogs had been rooting. It did very well.

Mr. J. S. Holmes, Bowmans Bluff, Henderson County, N. C.:

The seed was sown in two different plats. Plat A was fairly good upland soil on a steep hillside, facing the east, with a yellow clay subsoil. Plat B was poor, sandy, bottom land close to the river. The ground was plowed and harrowed and the seed sown broadcast on April 8, 1897, at the rate of 30 pounds to the acre. Plat A was harrowed in and plat B was covered with a garden rake. Plat A looks well and is taller than the trial plat of blue grama, but not so thick on the ground. We have had the thermometer down to 12° already, without snow, and it has not killed it. On plat B there is not a single plant. It came up all right, but was killed by the summer drought. Plat A survived the winter very well and quite a lot of it bloomed in the summer of 1898.

Mr. T. P. Kerr, Cambray, Donna Ana County, N. Mex.:

The seed was sown on alluvial soil in July. This is a native grass and did well. In its wild state it makes fine hay when it has plenty of rain.

Prof. T. L. Lyon, Experiment Station, Lincoln, Nebr.:

An upland, loamy soil, with considerable alkali and a tendency to pack, was used. The ground was plowed 8 inches deep and worked to a fine tilth. The seed was sown in rows, 6 inches apart, on May 5, 1897, on a 3 by 3 foot plat, and again broadcast May 30 on one-tenth of an acre. The grass bloomed about the first of August, 1898, and ripened about the end of August. The yield per acre was about 3½ tons of good feed. This is a promising grass for cultivation as it seeds abundantly and furnishes a large quantity of good hay. It has the disadvantage of starting its growth late in the spring and drying up in midsummer. It is not so hardy under cultivation as in the wild state, for all of it was killed out in the winter of 1898-99.

Mr. L. Miles, Sheridan, Kingfisher County, Okla.:

Some bottom land was well plowed and harrowed. The seed was sown broadcast on March 20 on timber land. None of this germinated, so I sowed again on April 2 on well-prepared soil. The seed ripened about August 15. I don't feel like condemning it, but I think trouble would be experienced in getting it to start, as our soil dries quickly after rain.

Mr. Samuel Roskelley, Logan, Cache County, Utah:

A virgin sage-brush upland was plowed 5 inches deep, harrowed, replowed 8 inches deep, then thoroughly harrowed. The seed was sown broadcast on April 16, 1897, and covered with a slanting-tooth harrow. I cut the crop on August 2, 1897, when it was just out of bloom, in order to save what I could, as the drought began to dry it up fast. It seemed to do reasonably well for the chance it had. The yield was about 2 tons per acre. It will no doubt make a good crop of hay of good quality. It withstood the drought better than the other varieties.

Mr. G. D. Tillman, Clarks Mills, Lexington County, S. C.:

The land was freestone soil in which grasses and forage plants are at a great disadvantage, owing to the lack of lime. The side oats grama is doing well and promises to be a good grass for this country. It spreads slowly, but surely, and stock likes it.

Mr. Henry Wehry, North Vernon, Jennings County, Ind.:

The soil was a stiff clay, underlaid with slate and fertile enough to produce any kind of a crop. The ground was plowed and harrowed and the seed was sown in

drills 6 inches apart on April 24, 1897. So far as I could observe the quality of the product was good. The yield was not large, but the rapid growth would perhaps fully repay the shortage of the yield. I consider it a valuable addition to our pasture grasses; a good variety to sow in a mixture for permanent pasture. We had plenty of rain all season.

BLUE GRAMA (*Bouteloua oligostachya*).

(Plate IV, fig. 2.)

A somewhat tufted or matted perennial, 6 inches to 2 feet high, with strong-growing rootstocks and numerous basal leaves. The inflorescence consists of usually 2 one-sided spikes on slender stems. It extends westward from Wisconsin to California and southward into Texas and northern Mexico. This grass improves very rapidly under cultivation. For several years it has grown luxuriantly in the experimental grounds of the Department at Washington, D. C., starting to green out about the middle of April and growing from 1½ to 2½ feet high, varying with the seasons. It is in full bloom about the middle of July and produces a fine growth of excellent hay. A fine aftermath appears soon after cutting, which affords excellent pasturage until injured by severe frosts in November.

No other grass better withstands the trampling of stock, and on the ranges it is considered among the very best for grazing purposes. During the dry season it cures in the turf into perfect hay, which is said to lose none of its nutritive value. Cattle are pastured on this hay all winter in the eastern Rocky Mountain region, where it is regarded as an exceedingly valuable grass.

Since 1896, 70 packages of the seed of blue grama have been distributed, but only 14 reports have been received. Of these, 5 experimenters failed to get any result, 3 considered it of little value, and 6 regarded it as a valuable grass for their districts.

The following are some of the reports that have been received from different States with widely varying climatic conditions:

Mr. J. S. Holmes, Bowmans Bluff, Henderson County, N. C.:

The land used was fairly good upland on a steep hillside facing the east. The seed was sown broadcast on April 8, 1898, and harrowed in. At this date, January 18, 1899, the grass looks quite alive and ready to make a good growth next year. It stood the long drought of August, September, and October, and seems to promise better than side oats grama (*Bouteloua curtipendula*).

Mr. P. T. Kerr, Cambray, Donna Ana County, N. Mex.:

This is a native grass and known here as grama, and grows luxuriantly when it has plenty of water. It is valued as fine grazing for both horses and cattle.

Mr. Henry W. Merrill, Hiram, Oxford County, Me.:

This grass did very well the first season, but I could not find a trace of it the following year.

Mr Samuel Roskelly, Logan, Cache County, Utah:

The land used was a virgin sage brush upland, which was plowed 5 inches deep, harrowed, reseeded 8 inches deep, then thoroughly harrowed again. The seed was sown April 16, 1897, and covered lightly with a slanting-tooth harrow. It was in full bloom about July 20 and cut August 2, to save what I could, as drought began to affect it considerably. The hay was of good quality and yielded probably about 1½ tons to the acre. The stand was rather poor, but what did come seems to have taken root well.

Mr. Henry Wehry, North Vernon, Jennings County, Ind.:

The seed was sown on well-prepared clay loam in the spring of 1898. The hay was of good quality, but the yield small. It does not grow quite as large as the side oats grama (*Bouteloua curtipendula*), but otherwise it is fully equal to it and would be a good grass to put in a mixture for permanent pastures.

BERMUDA GRASS (*Cynodon dactylon*).

A perennial grass, with a creeping habit of growth and upright flowering stems, which terminate in a finger-like inflorescence. It is dispersed throughout the tropical regions and warmer countries of the globe. Its value as a pasture grass is said to have been first noticed in this country by the late General Bethune, of Georgia, about 1825, who planted it in many places throughout the States. When the soil is poor the leaves are short and the upright stems only a few inches high, but on good land it grows to a height of 2 feet and yields a considerable amount of excellent hay. Throughout the South it is extensively used as a lawn grass where the grasses ordinarily used for lawns could not survive. The leaves, however, turn brown with the first frosts, so that it is only in the summer that this grass produces a green and pleasing lawn. The quickest method of producing a lawn of Bermuda grass is by cutting up a piece of the turf into small pieces and transplanting these from 6 inches to 1 foot apart. When once established, it is very persistent and difficult to eradicate, hence the advisability of keeping it out of land which is likely to be used for other crops. Bermuda grass does not mature seed, except in the extreme southern portion of our country, but imported seed can be obtained from the leading seedsmen. A variety known as St. Lucie grass is regarded as more desirable for lawns than the ordinary form, as it is of a finer texture, grows more rapidly, and is said to withstand quite severe frosts. As it does not root so deeply, it is less liable to become a pest by spreading into cultivated fields.

Since 1896, 22 packages of Bermuda grass have been distributed and 10 experimenters have complied with our request for a report on their success or failure. Out of these, 5 speak of it very highly and regard it as a valuable forage plant, 3 consider it of but little value, while 2 report complete failures.

The following reports will indicate the great value of Bermuda and St. Lucie grass to the South:

Mr. B. Atkinson, Waverly, Camden County, Ga.:

A well-drained, diked, river-bottom land was used. The soil was plowed and harrowed and the seed sown in drills about 2 feet apart. This experiment proved to be very satisfactory for the first year, but it is in the second year that there is profit in Bermuda grass. I have no doubt but that next year this experimental plot of land will yield at the rate of 4 tons to the acre.

Mr. F. A. Hendry, Thompson, Lee County, Fla.:

A package of Bermuda grass seed was received several years ago from the Department. It was sown broadcast and harrowed in. The seed usually matures about October, but sometimes earlier. For pasturage it is excellent, but I have never cut any for hay. It stands at the head of the list on rich, cultivated, moist lands, and under favorable conditions would produce at least 2 tons to the acre. It may be mown two or three times during the year.

Mr. E. O. Mitchell, Chattanooga, Hamilton County, Tenn.:

A small amount of the St. Lucie grass was sent to me last winter from Florida by mail. It was green when received, and in three days after it was planted we had a severe cold spell, the mercury going down 10° below zero. It withstood this and grew right along. A few days ago we transplanted from the parent bed a plot of ground about 12 feet square, and there is at present enough to plant another plot of equal size. This shows its aggressiveness. The parent stalks have thrown out runners in some instances 4 feet long, taking root at every joint. I have also the common Bermuda grass, but it does not appear to be nearly so aggressive as the St. Lucie. Furthermore, the St. Lucie remains green throughout heavy frosts. The friends who sent the sample to us said that frost could not kill it.

GIANT LYME-GRASS (*Elymus condensatus*).

(Plate V, fig. 1.)

A stout, erect, native perennial, 5 to 10 feet high, with long, flat, rigid leaves, dense spikes, and strong spreading rootstocks. It is common in the Rocky Mountain region and on the Pacific Slope, where it is found useful for holding the sand on railway banks. When young it makes hay of fair quality, and when allowed to stand it affords a considerable amount of forage for stock on the winter ranges.

Twenty-four packages have been distributed since 1896, but only 4 reports have been received, with 2 failures, 1 unsatisfactory, and 1 with good results.

Mr. George T. McWhorter, Riverton, Colbert County, Ala., reports as follows:

The seed was sown broadcast on a deep, smooth bed on March 1, 1899. It died down during the dry summer weather, but thrived after the fall rains and now looks well.

CANADIAN LYME-GRASS (*Elymus canadensis*).

(Plate V, fig. 2.)

A rather stout, smooth perennial, 3 to 5 feet high, with broad, flat leaves, 6 to 12 inches long. The inflorescence is in the form of a head



FIG. 1.—GIANT LYME GRASS (*ELYMUS CONDENSATUS*) AT EXPERIMENT STATION, BERKELEY, CAL.



FIG. 2.—VIEW IN GRASS STATION AT WALLA WALLA, WASH., SHOWING CANADIAN RYE GRASS (*ELYMUS CANADENSIS*).

From a photograph by F. Lamson-Scribner.

resembling the cultivated rye. It is found in almost all parts of the country in low thickets and along streams in rich, open woods. So far this grass has received very little attention. Some recent experiments, however, indicate that it has considerable value for pasture and hay. In the Northwest it is regarded as of some agricultural value for early pasturage, and in some places yields an excellent crop of hay. Mr. A. B. Leckenby, our special agent in charge of the grass and forage plant investigations on the Pacific coast, reports that it did remarkably well, producing two crops of seed, and suggests that it might be a useful grass to bring into cultivation. An equally good report comes from our special agent, Mr. H. L. Bentley, at Abilene, Tex. He found that it did well both on moist and dry land. It seeded out well and stood the long severe drought remarkably. The quality of the hay produced was very fine, and he considers it the best hay grass native to that part of Texas. The following is extracted from his report:

There are thousands of acres of moist valley lands that are annually cultivated in cotton and corn that could be put down to Canadian lyme-grass to much better advantage. I am satisfied that average valley lands in this section fairly well seeded with this grass will yield two good crops of hay every year, and that even a third crop is possible. After a second cutting here this year, in spite of the worst and longest drought ever known in this part of Texas, the third crop is now 12 to 16 inches tall and would afford excellent pasturage.

On the experimental grounds of the Department at Washington, D. C., this grass has also done very well, producing a fine growth $2\frac{1}{2}$ to 3 feet high. It was in full bloom about July 1, and cut for seed when fully ripe about August 15. By September 7 a vigorous aftermath 1 foot high had grown, which would have afforded excellent pasturage. The tufts are still (November 27) growing vigorously, although the tips of some of the leaves are yellowed by the heavy frosts. Twenty-two trial packages of the seed of Canadian lyme-grass have been distributed by this Division since 1896, but only 6 reports have been received. Of these 2 were failures, 2 unsatisfactory, and 2 good.

Mr. George T. McWhorter, Riverton, Colbert County, Ala., reports as follows:

The seed was sown on a well-prepared bed on March 1, 1899, and kept free from weeds. It came up, but died down during the summer, reviving again with the fall rains. We had a very long protracted drought this year, so that it is no criterion. It promises better than anything sown except buffalo grass.

MEADOW FESCUE: ENGLISH BLUE-GRASS (*Festuca pratensis*).

Meadow fescue is an erect, robust perennial, from 2 to 4 feet high, with numerous linear, glossy-green leaves and a branched panicle which is inclined to one side. It succeeds best on rather moist clay soils, such as are commonly found along creek bottoms, but will grow on almost all

soils. As it is one of the earliest grasses in the spring, and one of the latest in the fall, it makes an excellent grass for fall and winter pasturage. This is one of the most common of the fescue grasses, and, although introduced into this country from Great Britain over a hundred years ago, it does not yet receive the attention which it deserves. It is sometimes known as Randall grass, evergreen grass, and English blue grass, the last an unfortunate name, as it in no way resembles the *Poa*s, or true blue grasses. Many of our experimenters took this to be the Kentucky blue grass, and in consequence did not even attempt to sow the seed. The forage is much relished by cattle, either green or when cured for hay. When grown for hay it should always be mixed with other grasses. Redtop and alsike clover will grow well on the same kinds of soil, and the three make an excellent mixture for either temporary or permanent pastures.

A large quantity of the seed of meadow fescue was secured for the Department, through Prof. N. E. Hansen, during his visit to Russia, in 1898. This Division, through the Section of Seed and Plant Introduction, has distributed 424 packages, of 1½ pounds each, sufficient to sow one-twentieth of an acre, to all parts of the United States. One hundred and one reports have been received from the experimenters, giving in detail the results obtained and their estimates of its value. Very favorable reports have been received from Georgia, Indiana, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, Oregon, Washington, and Wyoming.

The following are some of these testimonials which have been received from the different States:

GEORGIA.

Mr. E. J. Hartman, Orr, Gilmer County:

The English blue grass has done splendidly so far. It seems to be an excellent grass for sheep, and if mixed with other grasses does also for cattle.

Mr. B. Lumsden, Macon, Bibb County:

The seed was received too late to sow. I planted some this spring near my fish pond in the shade and it is now looking quite well.

INDIANA.

Mr. Henry Wehry, North Vernon, Jennings County:

It seems to be well adapted to moist soils, as it grew to be 4 feet high and also made a good growth after it was cut for hay. It would be a splendid pasture grass.

IOWA.

Mr. C. Steinman, Mapleton, Monona County:

The seed was sown with oats about the last of April and did well.

Mr. S. H. Talley, Packwood, Jefferson County:

The quality of the product is very good. I think it an excellent grass for pasture. It grew three feet high the present year and is very hardy as to drought.

KANSAS.

Mr. Clark Belles, Burlington, Coffey County :

The seed was sown broadcast and the land afterwards harrowed twice with a smoothing harrow. The growth of this grass is about the same as the common meadow fescue that is grown to quite an extent in this country. It is quite valuable for seed, but not thought much of for pasture or hay.

Mr. A. Y. Bentley, Wallace, Wallace County:

The seed was sown by hand on a good clay loam on April 4, 1898, and covered with a garden rake. It was kept cut with a lawn mower once every ten days until late, then let go to seed. A fine growth was produced, and it is a good spreader. I think it will prove one of the best grasses for this climate.

Mr. N. Christensen, Mariadahl, Pottawatomie County:

The seed was sown in March. The grass grew well, and was mown two or three times with a lawn mower. It makes a good sod.

Mr. T. E. Pearce, Edgerton, Johnson County:

The English bluegrass was sown broadcast and lightly harrowed in. It grew well, but has not seeded yet, and will not for another year. When mixed with clover it makes one of our best pasture grasses. The yield of seed is about 8 to 20 bushels per acre. On good corn land it does well, but low, moist lands suit it best for heavy yields of pasturage. It is, perhaps, one of the most profitable pasture grasses we have. It starts to grow very early in spring, and grows very well in midsummer. It grows again very rapidly in the fall, unless extremely dry. After the seed crop is taken off, it can be cut later on for hay, which is very good.

MINNESOTA.

Mr. S. M. Warman, Sandstone, Pine County:

The yield per acre is about 2½ tons of hay of first-class quality. It grows rapidly and makes excellent pasturage. The hay is worth about \$8 per ton.

MISSOURI.

Mr. G. W. Covey, Laddonia, Audrain County :

The seed was sown broadcast on a heavy clay loam on April 9. It has not headed, but has produced a fine growth, and now covers the ground like a thick carpet. We have had a number of killing frosts, but they have not affected it. I shall turn sheep in to eat the grass during the winter. I think it will prove a good thing for our soil and climate.

MONTANA.

Mr. Wm. Flannery, Bozeman, Gallatin County :

The seed was sown broadcast on June 7, on new land composed of a sandy loam, then harrowed, rolled, and harrowed again with a light harrow. The crop was irrigated twice. I secured a good stand, but I can not form an opinion of its value until it has wintered and grown for another year.

Wm. W. Gamble & Sons, Burton, Teton County :

The seed was sown on May 19 with a hand seeder. The crop was irrigated. I secured a fine stand, and it seems to do well, but I can tell better about it next year.

Mr. W. H. Heideman, Kalispell, Flathead County :

A very rich, black, sandy loam was plowed deep, well worked up, and harrowed twice before seeding. The seed was sown broadcast on May 3, 1898, and then harrowed and rolled. The ground was quite weedy, so the plot was cut with a mower to keep the weeds down. The grass has grown well, considering the dry season, and must have great drought-resisting powers. It has kept wonderfully green and fresh, and has made some growth this fall in spite of the little rain. I have great confidence in this grass, and am now giving it third place. I will report further on it in 1899. Now that another year has passed I think more of it. I can not praise it too much. It does not seem to mind dry and hot spells. It is probably best for pasture, but it makes good hay.

Mr. R. A. Reynolds, Dillon, Beaverhead County:

A rich, low, bench land was used which had been summer fallowed and well prepared. The seed was sown with oats May 1, 1898, at the rate of 3 pecks to the acre and dragged in. The crop was irrigated twice during the summer. A good thick stand was secured and it ought to make a fine crop next year. The oats grew too rank and shaded the grass too much. I think it ought to make a good grass for this country.

Mr. C. C. Willis, Plains, Missoula County:

The seed was sown May 1, but owing to the dry season it did not grow thick enough to harvest. It grew about 1 foot high and is fine for grazing. I can tell more about English blue grass next summer, as it takes one year to form a sod. It seems to stand the dry weather well, but it should have been sown the first of April.

NEBRASKA.**Mr. Alfred Shirley, Weeping Water, Cass County:**

The seed was sown in March on the snow on the lawn. I secured a good stand, and I think it would be a good meadow or pasture grass. As it grows very rank, it is not good for lawns. I think it will be a success in this climate, as it is now in fine shape to stand the winter.

Mr. J. W. Williams, Weeping Water, Cass County:

The seed was sown broadcast April 6, 1898, and well harrowed in. I did not get a good stand, but what came up did very well.

NORTH DAKOTA.**Mr. William Britten, Sterling, Burleigh County:**

It seemed to die down when drought set in about August 1, but turned green in September when the fall rains set in. I think it would do well for lawns or pasture on low wet lands, but I do not think it would succeed on upland.

Mr. J. W. Higgs, Silverleaf, Dickey County:

The seed was sown April 16. It came up well and made a good growth until June 15. The seed did not mature, but the grass looked nice and green up to November 1. I think it will make a fine pasture if once established.

OREGON.**Mr. E. R. Reames, Klamath Falls, Klamath County.**

The seed was sown broadcast in May. The grass grew well and made a good growth. It was used for pasture.

Mr. J. O. Stemmler, Dora, Coos County:

The seed was sown broadcast April 10, 1898. It did not make much of a crop the first season and was not harvested until July 25, 1899. It grew about 2 feet high and produced about 20 bushels of seed per acre. It may prove to be of great value, as it seems to be adapted to this climate, ripens in good season, and makes a good growth.

WASHINGTON.**Mr. F. A. English, Farmington, Whitman County:**

The seed was sown broadcast May 15, 1898, on a deep, black, loamy, summer-fallowed soil. I secured a fine crop, which was fully 5 feet high. The yield per acre was about 2½ tons of good hay. It is a very valuable grass for pasture or hay in good loamy soil, which is neither too wet nor too dry. I would recommend it for sections with soils like mine. It should be grown extensively.

WYOMING.**Mr. G. A. Bell, Hyattville, Bighorn County:**

The English blue grass was very good. It stands drought well, but does not grow high enough for hay.

Mr. Robert Tait, Islay, Laramie County:

This seems to be a better grass for pasture than for hay, but it did very well for hay considering the backward spring and cold summer. I cut about the 1st of September, when it was nicely headed out and ripe. I think it a good grass for this climate.

CURLY MESQUIT (*Hilaria cenchroides*).

A delicate, perennial grass a few inches, to nearly 1 foot high, with slender, creeping runners and short, crisp leaves, which form a matted sward that improves under an amount of abuse and hard usage that would kill out less hardy grasses. It is one of the most valuable of the grasses of the dry plains and mesas of the Southwest, and in habit of growth closely resembles the true buffalo grass. During the summer it makes a dense, leafy turf, maturing on the ground, and in the fall and winter, when not rotted by late rains, affords excellent pasturage for all kinds of stock. No grass stands the long dry spells to which the Southwest is periodically subject better than curly mesquit. It commences to grow earlier in the spring than buffalo grass. Pastures may be sodded down to it by harrowing in bits of chopped up turf in the early spring after a rain, when the ground is soft, and in the course of a year a fine turf can be produced over the entire field. It is one of the best grasses for use in the renovation of the ranges. In dry summer weather it very often appears dead, but a few hours after a rain it becomes green again. Seed is produced in abundance, but it is difficult to harvest and of rather uncertain vitality.

Eighteen packages of the seed of this grass have been distributed for trial, but only one report has been received.

ITALIAN RYE GRASS (*Lolium italicum*).

A well-known, excellent hay and pasture grass introduced into this country from Europe about thirty-three years ago. It grows in broad, compact tufts, producing an immense growth of foliage from a single root cluster. Owing to its extremely rapid growth, cuttings may be obtained within three or four weeks from seeding, and at intervals of a month or six weeks successive crops may be harvested. Although it can be grown in almost all the States, it is better adapted to the middle latitudes and thrives best from southern Pennsylvania to Virginia. Because of its very rapid growth it is, like alfalfa, a good crop to rid land of weeds, as it quickly overshadows them, preventing the ripening of seed. This grass should always be cut for hay while in full bloom, as the stems rapidly become woody and unpalatable. It is not to be recommended for permanent pastures, as its duration is only two or three years; but for temporary meadows, and where a green growth is desired in a very short time it is an excellent grass. During the year 1898 twenty packages of the seed of this variety were distributed, and five reports have been received, two giving satisfactory results.

PERENNIAL RYE GRASS (*Lolium perenne*).

A vigorous perennial grass introduced into this country from Europe many years ago. On marshy lands, where the soil is good, it is one of the best pasture grasses. In such situations it will last from five to seven years, but on dry, sterile, upland soils it is short lived, rapidly disappearing after the second year. It stands pasturing well, and makes a quick recovery after having been closely cropped. The quality of the forage is very fine, being relished by all kinds of stock. For pasture on heavy soils in moist climates it is especially valuable, and under such conditions is largely used in mixtures for permanent pastures. As it grows very rapidly, a fine stand can be secured in a few weeks from the time of seeding. It is especially valuable when quick results are wanted and for covering the ground while other and more permanent varieties, like redtop or orchard grass, are becoming established. The form known as Pacey's perennial rye grass is said to be more vigorous than the species. Since 1896 twenty-five packages of perennial rye grass have been distributed, but only five experimenters have reported the results of their trials. The following are two of these reports:

Mr. Henry Wehry, North Vernon, Jennings County, Ind.:

The soil used was a rather stiff clay, underlaid with slate and inclined to bake after hard rains. The ground was plowed and harrowed before sowing. The seed was sown April 24, 1897, in drills 6 inches apart, and cultivated twice between the rows during the season. The late sowing was altogether against it, so that it grew to be only about 4 inches high. I secured a good stand, and think it will be a valuable addition to our hay-producing grasses. We had plenty of rain during the entire season.



FIG. 1.—JAPANESE BARNYARD MILLET (*PANICUM CRUS-GALLI*), GROWN AT WALLA WALLA, WASH.

From a photograph by A. B. Leckenby.



FIG. 2.—VIEW IN GRASS STATION AT WALLA WALLA, WASH., SHOWING RED LUMP MILLET ON THE LEFT AND METCALFE BEAN IN CENTER.

From a photograph by F. Lamson-Scribner, 1899.

Mr. James Lofthouse, Paradise, Cache County, Utah:

A black clay loam was plowed in the fall. The seed was sown the last of June, 1899, and raked in by hand. The crop received no cultivation, but was irrigated twice. It is at this date (November 15) about 6 inches long and nice and green. I think it will do well here and be very valuable for meadows and late pasturage.

SACCATON (*Muhlenbergia distichophylla*).

A rather coarse, firmly-rooted grass, 3 to 4 feet high, with long, narrow, rigid, drooping leaves and loosely flowered, somewhat narrow, panicles. It is a native of Arizona and New Mexico, where, together with *Sporobolus wrightii*, it is classed under the general name of Saccatone, which is the common term for native hay in those regions. This grass produces a large amount of dense foliage all through the dry summer weather, and might prove of considerable value if it could be introduced into cultivation. Eighteen packages of this seed have been distributed and six reports have been received. Most of those reporting have had poor success and do not consider it worth experimenting with.

JAPANESE BARNYARD MILLET (*Panicum crus-galli*).

(Plate VI, fig. 1.)

The seed of this variety was secured by Professor Brooks, of the Hatch Experiment Station, Massachusetts, from northern Japan, where the grain is used to a considerable extent as human food. It has been thoroughly tested and highly recommended as a forage crop by that station, and is considered superior to the "Ankee" millet because of its earliness. A crop of hay can be matured in about two and one-half months. It differs from the ordinary barnyard grass in its upright growth, finer branches or suckers, softer and lighter colored foliage, later and shorter season of ripening, compact awnless heads, and less ability to withstand drought. At the Hatch Experiment Station it has produced 67 bushels of seed, 11,297 pounds of straw, 18 tons of green fodder, or 6 tons of hay per acre. It is said to be superior to good corn fodder in feeding for milk, and in combination with soy beans makes very superior silage. Professor Brooks found by alternating the millet cut from day to day and fed green to cows with well-eared flint corn fodder, that the cows invariably increased in milk when put upon the millet and fell off when changed to the corn. From a peck to a half bushel of seed per acre, according to the richness of the land and the season of sowing, is sufficient. This millet will not endure drought well, hence the necessity of sowing early and harvesting a crop before the late, dry summer months begin.

Seventy-eight packages of Japanese barnyard millet have been distributed by this Division since 1896, 59 of which were obtained from, and grown at the Hatch Experiment Station. Most of the trials proved

to be failures, owing to the lateness of planting and the severe drought. Twenty-nine reports have been received, of which 14 record failures, 5 unsatisfactory, and 10 good results. The following are some of the reports which have been received:

Mr. E. M. Graham, Ruston, Lincoln County, La.:

Two plantings were made, on the 1st and 15th of April, 1899, respectively. The soil of the first planting was sandy, thoroughly pulverized and fertilized with manure from a cow lot. The second planting was on rich bottom land without any fertilizer, but the soil was thoroughly plowed. In both cases the seed was sown in drills about 30 inches apart. I did not harvest the millet until the seeds were fully matured, which was about the 10th of July. It makes good feed, cut green or cured. It grew off slowly at first, but more rapidly as its roots took to the soil. It was not a fair test, however, because of the severe dry weather in May and June and part of July. I think this millet will be a good crop for this climate, and could be sown by the 15th of March and harvested by the 15th of May. All stock relish it.

Mr. John Howat, Welton, Clinton County, Iowa:

The land used was a heavy, loam, prairie soil, underlaid with clay. It was well prepared by plowing, harrowing, and pulverizing with a disk cultivator. The seed was sown in drills, June 8, 1899. The land was cultivated twice with a corn cultivator, and the crop harvested on September 4, when ripe enough for seed. The yield is heavy, but the crop has not been thrashed yet, and its feeding value can not be estimated before winter feeding. This is without doubt a valuable variety of the barnyard millet, and will make a great crop of hay. Some of the seed which I sowed broadcast produced a crop that was laid down by a heavy storm, while that sown in drills came up again. I made an exhibit of the plants at our county fair. The stalks were 5 feet high.

Mr. Daniel McLaren, San Diego, San Diego County, Cal.:

The seed was planted in drills about the middle of April on well-prepared, heavy "adobe" soil. The millet was in full bloom about the middle of July. The millet was harvested about the middle of August when fully ripe. In quality it is good, but I could not do it full justice, as I was short of water. I am favorably impressed with its value as a forage plant, as stock is very fond of it, and it yields an abundance of seed.

Hon. H. C. Warner, Forestburg, Sanborn County, S. Dak.:

The seed was sown broadcast May 20, 1899, and harrowed in. I secured a perfect stand, but the drought of July, August, and September ruined the crop so that it failed to head. I have grown barnyard millet for three years previous to this, and it has proved very valuable for hay.

Mr. W. A. Wilkin, Salesville, Guernsey County, Ohio:

The yield per acre was about 2 tons. The quality of the hay was good, but coarse, and the growth very heavy. I believe it to be a valuable crop to help out when the hay crop is cut short by drought or other cause.

Mr. J. T. Wright, Anson, Jones County, Tex.:

The seed was sown in drills April 5, 1899. It matured a crop about June 20, and yielded about 2 tons per acre. The quality of the product is very good. This millet is a rapid grower, and, if the season permits, a second crop can be secured after the first cutting, which will double the yield. It should be harvested when in full bloom to make the best feed. I think it will be valuable, and I want to continue my experiments with it next season.

RED LUMP MILLET (*Panicum miliaceum*).

(Plate VI, fig. 2.)

The seed of this variety was received by the Department through Prof. N. E. Hansen, in February, 1898, from Orangeburg, Russia, on the boundary between European Russia and Siberia, where it is said to endure very severe drought. The seed is large and is much used by the peasants and Kirghiz Tartars for food. It is a variety of the common broom-corn millet of Europe, which has been in cultivation there for centuries. The branches of the panicle or head of red lump millet are shorter, more erect, denser, and closer together than the varieties of broom-corn millet commonly grown in this country. Its seeds are shiny and of a light reddish-brown color. It does not grow quite so tall as many of the other varieties, averaging only from 1 to 3 feet. It will be highly valued in the North and Northwest, owing to its ability to mature a crop of seed in a very short time. During the dry seasons, so often prevailing in those regions, it may, to some extent, serve as a substitute for corn. There is, perhaps, no other millet in this country that will produce such heavy yields of seed per acre. It seems to be well adapted to the climatic conditions of Kansas, as nearly all the experimenters in that State report having had excellent success, except for the ravages of chinch bugs and grasshoppers. In the States of Montana and Nebraska it gave very promising results, while in the Dakotas the seed is highly valued for chicken and hog feed, and sometimes as a substitute for corn in fattening cattle. It will probably never prove as valuable for hay as any of the foxtail and broom-corn millets now known in this country, because it does not produce as much leafage, and its stalks are inclined to be coarse, especially when thinly sown. In the spring of 1898, 360 5-pound packages of the seed of red lump millet were distributed by the division through the Section of Seed and Plant Introduction. One hundred and sixty-six reports have been received. The seed was distributed to volunteer experimenters in 34 different States, and reports have been received from Colorado, Kansas, Montana, Nebraska, North Dakota, Oklahoma Territory, Oregon, South Dakota, Washington, and Wyoming.

The following reports received from experimenters in the above States will testify as to its value as a forage plant for this country:

COLORADO.

Mr. E. E. T. Hazen, Holyoke, Phillips County:

A sandy, slightly gravelly loam was plowed 10 inches deep and harrowed twice. The seed was sown broadcast May 7, 1898, and the land harrowed twice after sowing. The millet was well up by May 25, and by August 1 it was thoroughly

ripe. It was fully ripe in about seventy-five days from the time of sowing and fifty days from the date of its coming up. The yield per acre would probably be about 58 bushels. The straw was not very long on account of drought, but the quality of both seed and straw was good.

Mr. W. H. Wilder, Trinidad, Las Animas County:

The seed was sown broadcast in the garden about June 29, 1899. It ripened about September 1, and yielded about 25 bushels of seed per acre. The quality of the forage was good but rather coarse. The red lump millet is a good thing, but for winter feed only.

KANSAS.

Mr. S. S. Dickinson, Larned, Pawnee County:

The land was plowed 8 inches deep, then harrowed and rolled. The seed was sown broadcast May 13, 1898, and harrowed in. By July 14 it was 18 inches high on an average and well filled with seed in the milk stage. It would have averaged 3 tons of hay to the acre.

Mr. C. P. Fullington, Wichita, Sedgwick County:

A black, sandy loam was plowed, harrowed, and rolled. The seed was sown broadcast July 1, 1898. It was in full bloom about August 5 and had ripened its seed by August 20. The quality of the product was good and the yield of seed particularly heavy. It grows well and has the appearance of being a good forage plant.

Mr. C. H. Jackson, Kidderville, Hodgeman County:

The land was plowed deep and the seed sown May 12, 1898. By August it had headed well with large heads filled with an abundance of seed. The plant grew to be about 12 inches high. The seed was so heavy that it was impossible to gather it except by hand. If it had been planted thicker on the ground it would have been practicable to harvest it with a header. The seed might make good hog feed if it could be saved.

Mr. M. Mellinger, St. Francis, Cheyenne County:

A black, loamy soil was spring plowed and the seed sown broadcast May 1, 1898, and harrowed in. It was cut the 15th of July, before fully matured, on account of the danger of grasshoppers destroying it. I regard it as a valuable forage plant.

Mr. Mads. Olson, Mullinville, Kiowa County:

The soil used was old ground in good condition. The seed was sown with a press drill about the middle of May. I harvested it when fully ripe, the latter part of July. It grew very rapidly to a height of about 2 feet, producing very large seed heads. I have nearly a bushel of seed which I will sow next year on some new land. It seems to stand the dry weather better than the other millets.

MONTANA.

Mr. Marion Flaherty, Bozeman, Gallatin County:

A well-prepared sandy loam was used. The seed was sown by hand May 23, 1898, and harrowed in with a light harrow. By August 8 there was a heavy crop, well filled with good, plump seed. I want to try it for ensilage, as the season is too short for corn here. I think it will be a valuable crop for the silo. I will sow about 5 acres of it next season. If its fattening qualities are good it would be useful here as a substitute for corn for fattening cattle.

Mr. Daniel Fratt, Billings, Yellowstone County:

A sandy soil was plowed in the spring and the seed was sown about May 20, 1898, and harrowed in. Part of it was irrigated and part not. It was fully matured about September 8. The plant makes a fine growth and is well adapted to this soil and climate. It yields well, but I have not been out to my ranch since it was thrashed. This millet would be valuable for hay here when labor is cheap; but owing to its having to be sown each year, and the seed harvested and thrashed, it is not profitable in this part of the State, where labor is \$35 per month.

Mr. G. M. Lewis, Meyersburg, Park County:

A stiff, rich soil was plowed deep and thoroughly disked and harrowed before sowing. The 5 pounds of seed were sown broadcast June 6, 1898, on one-fourth of an acre, and covered with a tooth harrow. It was cut for hay about September 15, when the blossoms began to fall. A strong growth 4 feet high was produced which stood out well. Some of it was irrigated once with reservoir manure, which accelerated the growth considerably. A slight frost which affected potatoes did not affect the millet. The yield was probably from about 3½ to 4 tons per acre.

Mr. Emory Vine, Miles City, Custer County:

A sandy loam was plowed and harrowed in the usual way. The seed was sown broadcast about the last of May and harrowed in. The crop was harvested for seed about the 1st of September. It was not very good for hay, but it seems to be a good drought resister, and I am inclined to think it would be a good forage for this country where they can not irrigate.

Mr. C. C. Willis, Plains, Missoula County:

The seed was sown May 4, 1898, on dry bench land. I did not secure a very good stand. The plants grew to be about 2 feet high, and were in full bloom about July 20, the seed ripening about August 15. If I had secured a good stand I would have had 3 or 4 tons to the acre. It has large, well-filled heads, and is a fine, rich feed. I think it would be a good fat and milk producer. In 1899 the crop of red-lump millet was very rank and thrifty, stooling well with a great deal of foliage on the stalks. This year I failed to raise any seed on account of so much rain. I think it a good forage plant for this country.

NEBRASKA.**Mr. Edward Barnes, Dorchester, Saline County:**

A black loam was plowed and harrowed fine. The seed was sown June 1, 1899. The millet was just going out of bloom August 15. The yield per acre was about 3 tons. It is an excellent forage for cattle and horses.

Mr. M. H. Chase, Palisade, Hitchcock County:

A black, buffalo-grass land was used. The soil was put in fine condition, and the seed was sown broadcast May 24, 1898, and harrowed in. The quality of the product was very fine. In comparison with a similar kind of millet raised here it seems to be very much better. The yield of seed was about 15 bushels per acre. I sowed it too thin in order to get more seed, and in consequence was troubled with weeds.

Mr. Alfred Shirley, Weeping Water, Cass County:

A light soil was prepared with disk harrow and the seed sown by hand May 10, 1898, and harrowed in. The millet was in full bloom by August 1, and ripe about the last of August. It makes a strong, vigorous growth far exceeding any other variety of millet grown in this section. It can be grown successfully, and in this State can not be recommended too highly.

NORTH DAKOTA.

Mr. William Brittin, Sterling, Burleigh County:

A sandy soil, which had been in cultivation for fourteen years, was spring plowed and harrowed into good condition although rather dry for seed to germinate in. Five pounds of seed were sown May 12, 1898, with a shoe drill on one-seventh of an acre. It should have been sown a little thinner. A heavy rain fell May 21 and the seed came up May 24, making a good growth until the July drought set in, which stunted the yield of straw and blasted a portion of the seed. I think the red-lump millet will do well here. The seed ripened about August 10 and yielded about 3½ bushels to the acre.

Mr. W. Hanson, Englevale, Ransom County:

A very dry, clay loam was spring plowed and well harrowed. The seed was sown broadcast May 20, 1898. I did not cut any for hay, but the seed ripened about August 15. I believe it will do well as a seed-growing crop. It appears to be a good yielder.

Mr. J. W. Higgs, Silverleaf, Dickey County:

The seed was sown broadcast May 27, 1898. The millet made a very fast growth and was in full bloom by August 11. The yield of seed was about 18 bushels per acre. In a good season it would make a large crop of both hay and seed. I think it well adapted for this country. In 1899 I planted again, but it was not a good season for any of the millets. For hay the red-lump millet is not as good as the German millet, but for grain it is better than any other variety I know of. All stock prefer it to the hog millet. I shall have enough seed next year to supply the neighborhood.

Mr. H. S. Nichols, Oakes, Dickey County :

A black, sandy loam with clay subsoil was used. The seed was sown broadcast about May 15, 1898, and harrowed in. The crop was ripe about August 1 and yielded well, though I can not give the amount. This is a good plant for forage. When ground, stock relish it, and it seems to be equally as rich as maize. I intend continuing my experiments with this plant. The estimated yield in 1899 was 20 bushels per acre. It is excellent food for all kinds of stock, and does best in this locality when sown late. Some good crops were reported when sown as late as July 4. It is valuable for both grain and hay.

OKLAHOMA TERRITORY.

Mr. A. C. Aborn, Omega, Kingfisher County:

A dark, rich loam was plowed and well harrowed. The seed was sown broadcast in May, 1898. The crop reached maturity in July. I believe it will be a good millet for this country, but it did not have a fair test on account of the wet weather. I have saved enough seed to test it again.

Mr. C. L. Boyd, Redmoon, Roger Mills County:

A red, sandy, river-bottom loam that had been in cultivation for three years was used. In 1897 it produced 4 tons of German millet per acre, which grew 6 feet high. The ground was broken in February, rebroken in April, then harrowed down fine. The seed was sown broadcast April 26, 1898, harrowed in with a light harrow, and afterwards rolled. Excessive rains in May and June produced so much overflow and

standing water that it did not have a fair chance and grew only 1 foot high, 50 per cent of it being drowned out. I do not consider it of much value for forage, but as a grain feed, under more favorable circumstances, it would yield at least 50 bushels of good grain per acre.

OREGON.

Mr. E. R. Reames, Klamath Falls, Klamath County:

A sandy loam was plowed, harrowed, and well cultivated. The seed was sown broadcast April 20, 1898, and covered with a harrow. The plants bloomed August 25, and ripened seed by September 10. The quality of the product was good. Having but a small quantity of seed I could not estimate the yield per acre, but it was very heavy. It grew about 15 inches high, with very large heads containing plump seed.

Mr. J. O. Stemmler, Dora, Coos County:

Second bottom land was used. The seed was sown broadcast May 1, 1898. The millet was in full bloom by July 15, and ripened seed by September 1. The yield per acre was about $3\frac{1}{2}$ or 4 tons. This millet grows very well on good land and yields all that any reasonable person should desire. Its probable value is about \$3 per bushel.

SOUTH DAKOTA.

Hon. H. C. Warner, Forestburg, Sanborn County:

A sandy loam was plowed and harrowed. The seed was sown broadcast June 1, 1898, and harrowed in. The millet ripened by September 1 and produced a good quality of seed. This variety was planted along with 12 other varieties of millet and proved to be more productive of seed than any of them. It received first premium at the State fair for the best peck of millet seed. For poultry feed or for grinding for hog feed it will be best of all.

WASHINGTON.

Mr. W. E. Lawrence, Toppenish, Yakima County:

An alluvial soil was used that had the sage taken off, then plowed 10 inches deep, and harrowed. The seed was sown in drills 10 inches apart April 1, 1899. The crop was fully ripe by June 10. The yield per acre was about 4 tons of hay and 900 pounds of seed. The hay is extra good for cattle. This millet grows best on good soil, just damp enough for germination, and will not stand much irrigation. When cut green it makes excellent cattle feed. The seed is one of the best feeds for poultry and sells readily at 10 cents per pound.

WYOMING.

Mr. W. R. Williams, Ten Sleep, Bighorn County:

A sandy loam was plowed and put into good condition. The seed was sown broadcast May 12, 1898, and harrowed in. The crop was irrigated once. It was very ripe by August 10. The quality of the product is very good. I consider this one of our best crops for hogs and chickens. I raised 6 bushels of seed from the 5 pounds sent me. My neighbors all like it, and I have given away 2 bushels of seed in small quantities.

FOXTAIL MILLETS (*Chætochloa italica* and var. *germanica*).¹

(Plate VII, fig. 2.)

The foxtail millets are by far the most important group of millets grown in this country. They have a compact, bristly, foxtail-like head and are said to have evolutionized from the common foxtail grasses of the fields and waste places. To this group belong the common, German, and Hungarian millets with their many-named forms and varieties.

"The common millet is the most widely cultivated of the foxtail millets in this country at the present time. It is the hardiest, most drought-resistant, and gives better returns on poor soils than the other commonly grown varieties. Although long known in Europe, it seems to have reached its perfection in this country, and is now being sold in Europe under such names as American millet and California millet."

"The German millet makes a heavy yield of forage under favorable conditions, but does not stand drought as well as the common and Hungarian millets. The hay is coarser and less highly valued than that from the other millets, but when the forage can be fed in the green state this will be found to be an excellent variety to grow on account of the heavy yield. Some of the so-called Japanese millets now on the market belong to the German millet type."

"The Hungarian millet or grass has been in cultivation in the United States since 1830, and probably much earlier. It first came into general cultivation in the Middle West. In Iowa it won favor at once, and as early as 1856 was a most valuable forage crop, particularly on recently broken land. At the present time it is more widely grown in the North than in the South. By most farmers it is placed next to the common millet as a hay crop, the quality being regarded as better than German millet.

"Hungarian millet does not resist drought as well as common millet, but with favorable conditions of soil and moisture it will usually give a somewhat heavier yield. One reason why Hungarian has not found more favor with farmers generally is that it shows a greater tendency than other common varieties to persist in the soil when allowed to mature seed before harvesting. In portions of the Missouri Valley region, as in eastern Nebraska and Iowa, this millet received a great deal of attention from farmers during the seventies, and fine crops of hay and seed were obtained, but its tendency to 'volunteer' brought it into more or less disfavor, and it is now less commonly grown than either common millet or German millet. It seldom becomes troublesome, however, except on light, sandy soils or land recently brought into cultivation. On moist, heavy soils or in regions where there is a great deal of wet weather during the fall and winter months it is not likely to make much volunteer growth."

¹ For full discussion on "Millets," see Farmers' Bulletin No. 101, United States Department of Agriculture.



FIG. 1.—BROOM-CORN MILLET GROWN AT NORTH YAKIMA, WASH.

From a photograph by A. B. Leckenby, 1899.



FIG. 2.—MILLET, FROM A VIEW IN GRASS STATION AT NORTH YAKIMA, WASH.

From a photograph by A. B. Leckenby, 1899.



FIG. 1.—COLLECTING SEED FOR UNITED STATES DEPARTMENT OF AGRICULTURE, DIVISION OF AGROSTOLOGY, OF SEASIDE BLUE GRASS NEAR MORRISON, OREG.

From a photograph by A. B. Leckenby, 1899.

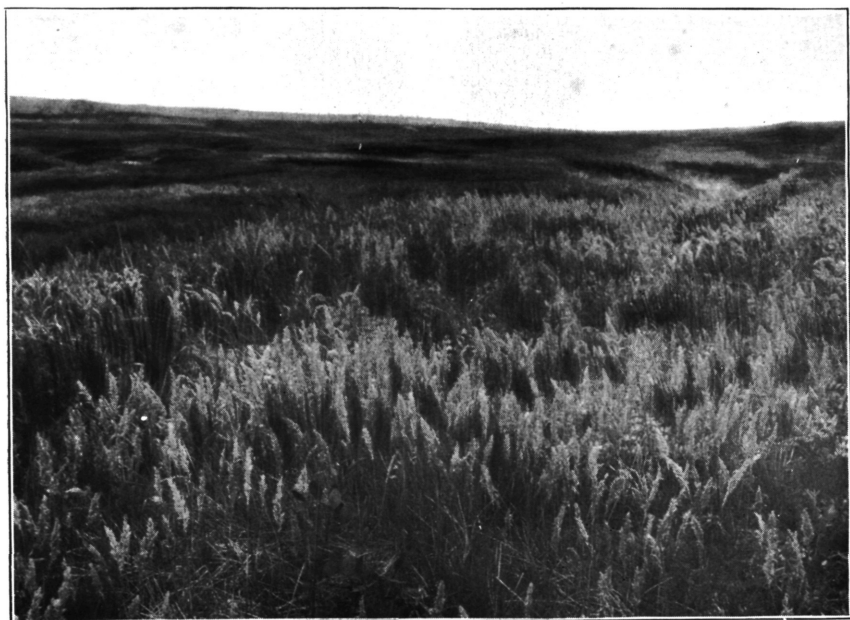


FIG. 2.—SEASIDE OR ASTORIA BLUE GRASS (*POA MACRANTHA*).

From photograph taken near Morrison, Oreg., by A. B. Leckenby, 1899.

Since 1896 thirty-one packages of different forms and varieties of foxtail millets have been distributed by this division, and 12 satisfactory reports have been received.

The following report from Mr. C. E. Kittinger, of Powell, S. Dak., is of much interest to the farmers of that region:

Next to the grasses were sown the following kinds of millets: Japanese Foxtail millet (*Chætochloa italica*), Japanese barnyard millet (*Panicum crus-galli*), Red Japanese Broom-corn millet (*Panicum miliaceum*), Early Harvest, Golden Wonder, Buckbee's California Beauty, Manitoba, common, and Hungarian millets.

All of the Japanese millets grew tall and coarse, and were late in maturing, especially the first two varieties. The stalks grew nearly 4 feet high, as large as lead pencils, and when ripe were about as woody. The heads were erect and very compact. The red Japanese was the first one to ripen and the worst to shell out of the three varieties. In growth it resembles broom-corn millet. Early harvest grew much like common millet, and was the first of all to mature. Golden wonder grew larger than any other variety, with coarse, woody stems. It was late in ripening and lodged badly before mature. It had a large amount of leaves on the stem, and on poorer ground or with less rain might have made good hay if cut early. Buckbee's California beauty grew large and coarse, with long, drooping heads of large seed, but was later than common millet. Manitoba millet grew much like broom-corn millet and shelled badly. Hungarian grass is much like common millet, but has a more leafy stem, and the seeds are brown instead of yellow. Most of these grew larger than common millet and were later in maturing. Under different conditions, they would no doubt have been smaller, but taking all things into consideration, none of the varieties tested promise greater usefulness than the common millet.

Millet is one of the best forage plants that can be grown in this section, but when intended for hay ought to be cut before the seed is ripe. It is much harder to cure than prairie hay, and it ought to lay in the windrows or bunches until thoroughly dried, or it will heat and mold in the stack, while if left to thoroughly cure before raking up it will bleach badly, and bleaching spoils its nutrition. Hay ought to be cured without being exposed to direct sunshine, but that is not possible to do on a large scale. It can be raked green and allowed to dry in the windrow, so that only a small part of it will be exposed. The old adage, "Make hay while the sun shines," should be revised to read, "Make hay while the wind blows."

SEASIDE BLUE GRASS (*Poa macrantha*.)

(Plate VIII, figs. 1 and 2, and Plate XIII, fig 2.)

A smooth, stout grass 1 to 2 feet high, with strongly creeping root-stocks, dense, erect panicles, and very large spikelets. It is found growing abundantly on the sand dunes along the Pacific coast, where it is highly valued for its sand-binding qualities. At the grass station at Walla Walla, Wash., it has given excellent results, showing but little the effects of frost, and promises to be of great value for forage. Experiments which have been carried on by sowing the seed on the sands bordering the Great Lakes indicate that it may prove valuable as a sand binder, not only along the seacoast, but also in the sandy regions of the interior.

Eighteen packages of seaside blue-grass seed collected by special

agents on the Pacific coast (see Plate VIII, fig. 1) were distributed by this division during the fiscal year 1898-99.

Only 4 reports have been received from experimenters along the Atlantic coast. In 2 cases the seeds failed to germinate and the others secured a fair stand of plants from 6 inches to 1 foot high. Further experimentation is necessary before we will be able to state the value of this grass to the Atlantic coast and the lake regions of the interior.

MISCELLANEOUS FORAGE PLANTS.

DWARF ESSEX RAPE (*Brassica napus*).¹

(Plate IX, figs. 1 and 2.)

A succulent, nutritious biennial forage plant with large, glaucous, smooth, spreading leaves, which has been widely cultivated in the northern United States and Canada. Its area of usefulness, however, might be made to extend more largely to the West and Northwest, as there are many places it may occupy in the rotation of crops on the farm. By the use of irrigation excellent crops of rape can be grown in the semiarid regions, and recent reports indicate that it will withstand quite severe drought if well cultivated. It makes an excellent feed for fattening sheep and is a valuable food for young lambs at weaning time. Rape will endure quite severe cold weather, and sheep can be pastured on it late into the winter, until the snow covers it up. Animals should not be turned into the rape pastures when the leaves are wet, for fear of bloating, and they have been found to do better when they have access to an open grass pasture as well as to the rape. There are several varieties of rape, but the Dwarf Essex is the most widely cultivated. Under average conditions a yield of from 10 to 20 tons or more per acre may be expected, although much heavier yields have been recorded. Mr. W. H. Heideman, of Kalispell, Flathead County, Mont., has had wonderful success with this plant for several years. He regards it as one of the greatest forage plants known. He cut it three times the first season for feed, and the second season secured a fine yield of first-class seed. The illustration (Plate IX, fig. 1) represents a single plant grown by him from his own seed.

Sixty-one small packages of the seed of this variety were distributed in the spring of 1899, but so far only 12 reports have been received from the experimenters, with 2 failures, 2 unsatisfactory, 2 good, and 6 excellent reports.

The following are some of the reports received from different States:

Mr. Thomas Ashcroft, Ashcroft, Harding County, S. Dak.:

The seed was sown broadcast in June as soon as the land could be plowed, and then harrowed down before it dried hard. The land was not cultivated in any way

¹ For full discussion of "Rape as a forage plant" see Circular No. 12, Division of Agrostology, U. S. Department of Agriculture, Washington, D. C.

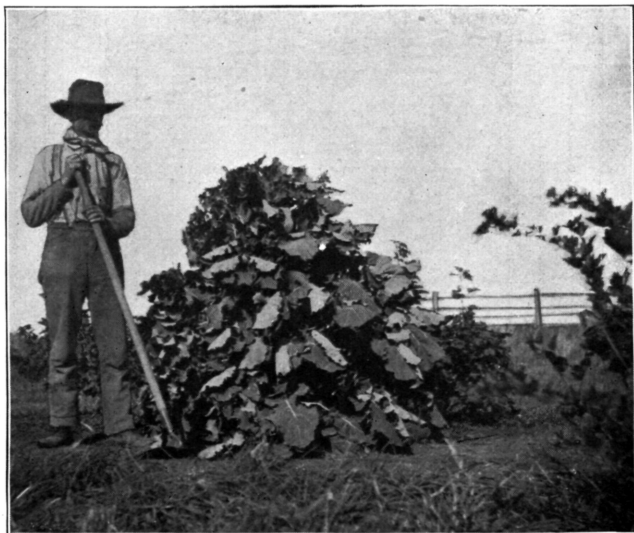


FIG. 1.—A SINGLE PLANT OF DWARF ESSEX RAPE, GROWN BY MR. W. H. HEIDEMAN, KALISPELL, MONT.

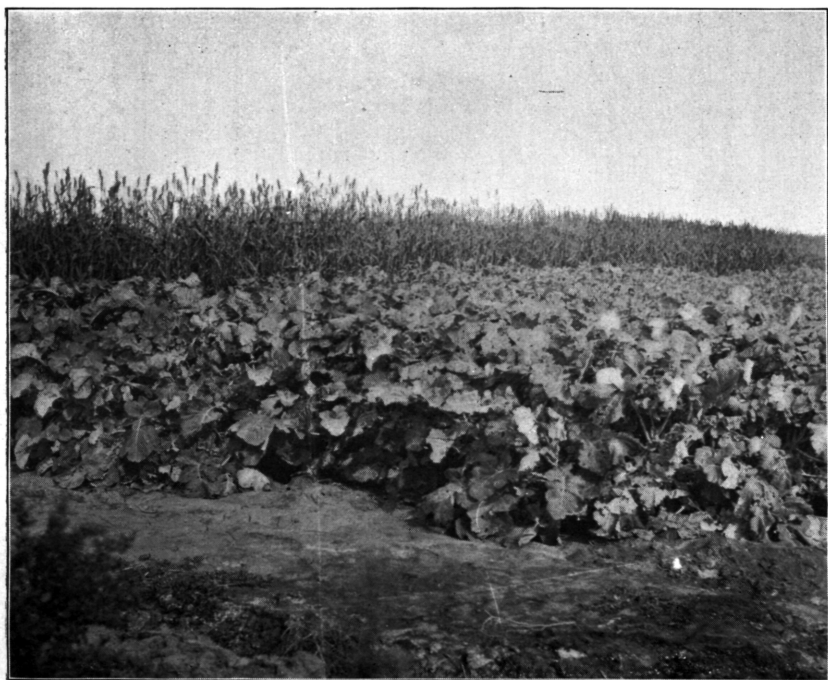


FIG. 2.—RAPE GROWN AT MELLETTE, S. DAK.

after sowing. The rape grew to perfection, and I am still cutting it (November 10) and have been for six weeks feeding it to our milch cows. It does not affect the butter and is an excellent plant to bring them home before sunset. It is quite green yet and will not ripen. If weighed as soon as cut, I should judge it would give about 20 tons to the acre. Its value is incalculable. We began to give it to calves in the pen as soon as the commencement of hay time. Everything appears to like it. Cows eat it with avidity. It is quite the wonder of the neighborhood. I have been asked more than forty times, "What is that green stuff down there?"

Mr. Will Crosier, St Edward, Boone County, Nebr.:

The seed was sown broadcast May 30 on a well-prepared black loamy soil. It kept growing until fall, and I think it would make an excellent forage plant for pasturage.

Mr. J. E. Krasomil, Atlanta, Phelps County, Nebr.:

The seed was sown broadcast April 10 on a well-prepared moist, rich, black, loamy soil. It did splendidly, but I did not do anything with it. It now stands 14 inches high, and the frost has no affect on it.

Mr. J. B. Nixon, Charleston, Franklin County, Ark.:

A rich common prairie soil was used. The seed was sown in drills May 3. It was well cultivated to keep the ground mellow and free from weeds and grass. The quality of the product was good and the growth rapid. The leaves are large and succulent and greatly relished by cattle and hogs. I consider it will be a most useful green fodder and forage plant.

SULLA (*Hedysarum coronarium*).

A strongly rooted, vigorous, perennial legume with numerous very succulent, radical, compound leaves, varying in height from 1 to 6 feet, according to soil and climatic conditions. It is a native of southern Italy and was first introduced into cultivation in 1766. For the warmer sections of the United States, subject to long-protracted drought, sulla may prove a most valuable forage plant, and is worthy of extensive trials in Texas, Florida, and other Gulf States. It will withstand slight frosts, but is killed if the roots are frozen. The practice is to sow the seeds in September or October on land that has been deeply plowed and thoroughly pulverized, either alone or with winter wheat or oats. In feeding value it compares very favorably with red clover and alfalfa. It is best adapted to tropical and subtropical climates.

Our special agent at Abilene, Tex., reports having had very fair success with it. The seed was sown May 4. It grew vigorously from the start, and by the time the hot and dry winds began, early in July, it had reached a growth of from 6 to 12 inches. The long four months' drought, however, caused the leaves to wither and die, but the roots held their own and continued to grow down into the earth. On the approach of rain in the fall the plant was soon green again. He believes that it is going to prove of much value and that it should be tested in all sections of Texas.

Twenty-nine packages of the seed of sulla were distributed in 1898 and 10 reports have been received, only a few of which are satisfactory.

Mr. O. S. Herrington, Dollie, Jones County, Miss., reports:

A sandy, pine ridge in first-class condition was prepared as for cotton. The seed was sown broadcast. On account of dry weather I failed to get a stand until December 1. There is no doubt but that sulla will do well here. I scattered some seed on unprepared land, and it came up with the first rains, and now looks as thrifty as that on the prepared land. I shall be glad to report again later on.

TURKESTAN ALFALFA (*Medicago sativa* var. *turkestanica*).

(Plate X, fig. 1.)

This variety of alfalfa was received for the Department, through Prof. N. E. Hansen, from eight localities in Russian Turkestan, in June, 1898. It is found growing from the cotton-growing sections of Bokhara and other parts of Russian Turkestan, into western China and to its northern limits near Kopal, Siberia.

Prince Massalski, of the Department of Agriculture at St. Petersburg, writes (*The Industries of Russia*, Vol. III, p. 459):

Lucern-clover (*Medicago sativa* var. *turkestanica*) is the chief forage in use throughout Central Asia, and to the settled population of Turkestan is of the highest importance, since during the summer it forms the chief, and in winter, prepared in the shape of hay, the only fodder for cattle. It is of all the greater importance because within the region populated by settled inhabitants there are no meadows. Soft herbs and other grasses that grow up in the early spring in certain parts of the steppes are quickly dried up by the hot rays of the sun, and give place to coarse, prickly stubble, or in any case to less nutritive grasses that are in general unfitted for sheep, camels, or steppe cattle, and still less fitted for horses or the cattle of those who are settled in the oases, and are thus closely confined to the forelands or rivers, and in most cases are far removed from the steppes.

Prince Massalski describes the native methods of cultivation and irrigation, and continues:

The native lucern would seem to be a cattle fodder that can not be replaced in countries so dry and so hot as Turkestan and the Transcaspian Province. Parallel experiments that have been made in the Merv oases, in the Transcaspian Province, in sowing native and French lucern, particularly where there is a lack of water, show that it is vastly superior to the French in the crops it yields, and that it is able to grow satisfactorily with a minimum supply of water, a supply so small that European lucern would perish from drought. This peculiarity of the native lucern is to be explained by its peculiar structure. It possesses a very large root system, and its leaves are covered with thick down; this, in conjunction with a deep-cut channel on the leaf, enables the plant on the one hand to imbibe the moisture from the deeper layers of the soil, and on the other hand to exhale it in very small quantity.

Alfalfa is extensively grown throughout the entire United States with the exception of New England. It is a deep feeder. The taproot descends to a great depth wherever the soil is loose and permeable,



FIG. 1.—TURKESTAN ALFALFA GROWN AT NORTH YAKIMA, WASH., 1898.



FIG. 2.—ALFALFA, BELLEFOURCHE, S. DAK., 1897.

often averaging 10 to 15 feet, while extraordinary depths of 50 to 60 feet have been recorded. The feeding value of alfalfa is very high, provided the crop is cut in due season. When cut in time and properly cured, alfalfa hay is an exceedingly valuable item in the farm economy. Wherever the soil and climate are adapted to it, a field of alfalfa should be on every man's farm.

In 1898 and 1899 three hundred and twenty-three packages of Turkestan alfalfa, of 10 pounds each were distributed by this Division through the Section of Seed and Plant Introduction.¹ This distribution included experimenters in 35 different States. Up to the present time 148 reports have been received, and already the general opinion seems to be that it is a better drought-resister than the French and Chilian alfalfas. Many, however, are inclined to believe that it is no better than the common alfalfa growing in their particular section. Others again failed to get a stand. In many instances this has been caused by experimenters not keeping the weeds down the first year. Care must be given until the young plants get a good hold on the ground.

It is not advisable to try to grow a crop of seed the first year, especially in sections of the country that suffer from severe drought and where irrigation can not be carried on. The energies of the plant are all required to produce a strong and deep root system. It will be found that if the first year's growth is cut down just previous to the long, dry, summer months, that the roots will grow much deeper down into the soil, where, during the period of drought, they will be more likely to find sufficient moisture.

In the grass garden of the Department of Agriculture, Washington, D. C., the Turkestan alfalfa grew two feet high and very rank and thrifty. Three crops were produced which were fully equal to the native varieties from different States growing alongside of it. The height, amount of growth, and quality of the hay of the Turkestan alfalfa seem to be about the same as the French alfalfa.

Experiments have not been carried on for a sufficient number of years to enable us to state its future in this country. The present indications are that it will be of considerable value to the farmers in the semiarid regions of the West where irrigation can not be carried on.

The following are a few of the reports that have been received by this Division. The majority of experimenters do not care to come to any conclusion until they have tested it for a longer period.

¹ A total of 1,111 packages of Turkestan alfalfa have been distributed by the Department and 438 reports have been received from the experimenters. The detailed results from the entire distribution will soon be published separately.

COLORADO.

Mr. Adolph Froelich, Aroya, Cheyenne County:

A sandy loam, broken last year, was plowed about six inches deep this spring. The seed was sown broadcast May 9, 1899, when the ground was very dry, and harrowed in. We had less than the usual amount of rain; in fact, the driest season in eighteen years. The alfalfa began to bloom August 1, and I cut it with a scythe and left it on the ground. It soon grew up again 18 inches high. I irrigated part of it, first when sown and again the 8th of August. That irrigated made a fine stand, but that not irrigated was a total failure, only 25 plants coming in a plat 150 by 10 feet. It held its own better after it came up than our common alfalfa would have done; that is, where a good stand was first obtained by irrigation.

GEORGIA.

Mr. E. J. Hartman, Orr, Gilmer County:

The soil was well prepared and the seed sown broadcast about the end of May and lightly harrowed. The alfalfa gave two good cuttings of excellent quality. It has done wonderfully well on our soil. I have a fine stand now, and I hope to get fine crops next year.

INDIANA.

Miss Kate A. Drake, Elkhart, Elkhart County:

A poor, sandy soil was plowed and dragged. The seed was sown in the fall of 1898 after a rain. It came up nicely and grew well. We had a very severe winter and some of the alfalfa froze out, but a large part of it came on again in the spring. This grew finely, some of it reaching 18 inches in height. The severe drought caused it to dry up, but did not kill it, as part of it has come up this fall (1899) and looks very fine. I would like to send you a report next summer, after I see if it dries up again. I believe it would be adapted to our soil and be a valuable acquisition.

Mr. M. F. Eastman, North Vernon, Jennings County:

A clay loam was well prepared and the seed sown broadcast in March, 1899. The plat, 10 by 200 feet, has been cut three times this season, which has been a very dry one. The yield was very heavy at each cutting, averaging at least 2 tons per acre. I believe it to be a paying crop if a catch can be secured, but owing to its slow growth it is hard to get a stand.

KANSAS.

Mr. A. Y. Bentley, Wallace, Wallace County:

A good sandy loam that had been in cultivation for several years was used. The seed was sown May 12, 1898, and we had rain on the 13th and 14th. I mowed the field when the alfalfa was about 7 inches high and left it on the ground. The grasshoppers kept the plants eaten down to the crown. It came up again and is a good stand now. I sowed several patches of lucern in the spring and the grasshoppers took them all, just as they did the Turkestan, which is the only patch that survived.

Mr. Ben Brown, Natoma, Osborne County:

A rich, light, prairie soil was plowed and harrowed twice. One pound of seed was sown on an acre about May 27, 1898. A good stand was up by June 3. The plants grew well until checked by drought in July and August, but were not seriously injured.

Since the heavy rains of September 8 to 14 the alfalfa has grown from 8 to 10 inches high and is green now. It looks promising for further crops. I have 80 acres of common alfalfa which I cut 4 times each season, getting from 4 to 6 tons to the acre. This does not give a full crop until the third or fourth year. If the Turkestan alfalfa beats this it will do well.

Mr. H. C. Hollowell, Barnes, Washington County:

A dry, black loam was plowed early and harrowed. The seed was sown broadcast about May 20, 1898, and harrowed in. The growth was short, but it stood the dry weather well. I think it better than our common alfalfa.

Mr. C. H. Jackson, Kidderville, Hodgeman County:

The seed was sown May 12, 1898. The alfalfa grew about 6 inches high by the first frost. The dry weather tested it severely, but it would green up now if we had a little rain. This is the only variety of alfalfa that seems to offer a chance for successful cultivation in this part of the State.

Mr. Mads Olson, Mullinville, Kiowa County:

The soil was second sod, in good condition. The seed was drilled in the last day of May, 1898. It came up as pretty as anything I ever saw, and was nicely in bloom when the grasshoppers came and destroyed it.

Messrs. William B. Sutton & Sons, Russell, Russell County:

A new piece of black loam was broken and finely cut up with a disk. The seed was sown broadcast about May 1. The season was very dry, but we obtained a fine stand 8 inches high. It withstood the drought well and is growing quite nicely. This has been a poor season to test it; even 4-year old alfalfa made only one small cutting. There was no rain in June, July, or August.

MONTANA.

Messrs. W. W. Gamble & Sons, Choteau, Teton County:

A gravelly loam on bench land was well plowed and harrowed. The seed was sown broadcast May 19, 1898, with a hand seeder. No cultivation was given except irrigation. The alfalfa was in full bloom in July and ripened in August. The quality of the product was good. This seems to be a better plant in its growth than the ordinary alfalfa. The winter of 1898-99 seemed quite trying on alfalfa, with a tendency to winterkill. In the spring of 1899 our ordinary alfalfa came up bunchy in appearance, and although it recovered itself later in the season, the growth was irregular. The Turkestan alfalfa, however, grew even and uniform throughout the season under precisely the same conditions. It is probably a better variety than the ordinary alfalfa grown here.

Mr. W. H. Heideman, Kalispell, Flathead County:

The soil was very light, sandy, and open, varying to a black sandy loam. The land was plowed thoroughly, harrowed, then rolled and harrowed again. The seed was sown broadcast, then smoothed with a harrow and rolled again. The plants came up May 18, and were in full bloom by July 28. The crop was cut with a mower along with the weeds. So far as the experiment has gone it is very good. I think it has done remarkably well for the first year. The weather has been very hot and dry, with no rain since June, and the drought seemed to affect it but little. It was 14 inches high on July 28, 1898. The winter of 1898-99 was very severe, but none of the alfalfa was winterkilled. The year 1899 was very dry in the fore part of the

season, but a great deal of rain has fallen since August 1. The plat of Turkestan alfalfa still continues to do well. It was fed down by hogs till May 28, and then let grow for seed. It made a great growth, but did not fill very well, the cold weather probably having something to do with it. After cutting, it grew up again rapidly. I think it is going to be more valuable than the common alfalfa. It seems to do well on alkali spots. I would advise all to sow it as soon as they can secure seed.

Mr. Len. Lewis, Lewis, Meagher County:

Dry limestone bench land was used. A good strong growth was secured. It seems to be hardier than the ordinary alfalfa. I think it is a valuable acquisition.

Mr. Emory Vine, Miles City, Custer County:

The Turkestan alfalfa wintered well, and is coming on this spring as if it meant business. At the present time it has a decided advantage over our common French alfalfa. It shows green several rods away, while our common alfalfa that was sown last season has not started to green yet.

NEBRASKA.

Mr. J. A. Anderson, Harrison, Sioux County:

A sandy soil in good condition was thoroughly prepared and irrigated. The seed was sown with oats May 15, 1898. The quality of the product was good, and I think it will make a valuable forage plant in this section. It did better than the common alfalfa.

Mr. J. W. Williams, Weeping Water, Cass County:

A fine black loam was plowed and harrowed. The seed was sown broadcast May 25, 1898. The plants made a very good growth and withstood our short drought very well, and are doing fine now. This variety did much better than our common alfalfa for the first year.

NEW MEXICO.

Mr. J. A. Gishwiller, Roswell, Chaves County:

A good clay loam was plowed three times and harrowed fine. The seed was sown broadcast July 13, 1898, and covered with a harrow. I secured a good stand. The growth was strong and vigorous and somewhat better than our common alfalfa sown on adjoining land. It will take another season to compare it with other alfalfa.

OKLAHOMA.

Mr. C. L. Boyd, Redmoon, Roger Mills County:

A black, sandy bottom soil was broken early in February and rebroken at the time of seeding and harrowed down fine. The seed was sown broadcast May 5, 1898, then harrowed and rolled. The quality of the Turkestan alfalfa was the finest I ever saw. I sowed alongside of it a plat of the common alfalfa and there was a marked difference between it and the Turkestan, the latter growing much ranker. I think the Turkestan the most valuable variety of alfalfa.

Mr. W. A. Rowan, Gallienas, Beaver County:

A sandy soil was plowed, well pulverized, and put into fine condition. The seed was sown broadcast May 9, 1898, and harrowed in. It was irrigated May 25, and again June 20. I secured a good stand, but it does not mature sufficiently the first year to make a good crop. It was sown by the side of some common alfalfa and given the same care. The Turkestan variety seems to be the stronger and hardier. The value of a good stand would be about \$30 per acre here.

OREGON.

Mr. W. A. Wintermeier, Silvies, Harney County:

A decayed lava and clay soil was used. The alfalfa came up very nicely and even. When about 3 inches high a severe frost cut it down. It grew up again, however, but was a second time cut down by frost, but still it grew to be 1 foot high. Apparently it will not stand frost as well as the French alfalfa, but seems to be better adapted to dry soils. Another year will determine what it will do in this part of the country.

SOUTH DAKOTA.

Mr. W. H. H. Phillips, Brookings, Brookings County:

A black loam with a clay subsoil was well harrowed and made fine. The seed was sown broadcast about May 20, 1898. In March, 1899, it was covered with barnyard manure. On May 17, 1899, it froze somewhat, which gave the weeds a start. I mowed it early in July. Since then it has made a good growth. The first year it made but little growth, but now (October, 1899) it is very promising.

Hon. H. C. Warner, Forestburg, Sanborn County:

A black sandy loam was plowed deep in the spring and well prepared by harrowing. The seed was sown broadcast April 24, 1898, and harrowed in. The stand was perfect, and notwithstanding the drought and a cold, open winter, without snow, the plants came through in perfect condition. The Turkestan alfalfa was not cut this season, judging that it is better to let alfalfa become well established first. Every root of common alfalfa growing by the side of it was killed.

TEXAS.

Mr. J. W. Cartwright, Amarillo, Potter County:

The seed was sown the latter part of September, 1899. It came up nicely and now looks fine, with 4 inches of snow on the ground. I am quite proud of this, and will report later on.

Mr. Arnott West, Brownwood, Brown County:

A rich, deep, black, slightly ashy soil was used. The quality of the product was good, and altogether, throughout the season, amounted to from 8 to 10 tons per acre. This variety stands the dry weather splendidly in this part of the country if it has a deep, well-drained soil. Alfalfa should be grown here exclusively. I am feeding 200 steers on it and they are getting fat.

UTAH.

Mr. James Lofthouse, Paradise, Cache County:

The seed was sown broadcast May 28, 1898, on a clay loam. The plants bloomed July 25, but were destroyed by stock before ripening seed. This variety will stand drought better than the kind of alfalfa commonly grown here. It grew 18 inches high, and where it got enough moisture it outgrew the common alfalfa under similar conditions.

Mr. Samuel Roskelley, Logan, Cache County:

A dry sagebrush upland that had been cultivated in wheat for three years was well plowed and harrowed. The seed was sown broadcast May 9, 1898, and harrowed in lightly. I consider this one of the best and most valuable fodders for dry

farms which are not irrigated in this western country. I have raised common lucern for twenty years, but for drought resistance I think this is better. My experience is that seed should not be raised from the first year's growth as by cutting before maturity it tends to send the roots down to find moisture.

OASIS ALFALFA (*Medicago sativa*).

This is a variety of alfalfa the seed of which was obtained from the director of agriculture and commerce of Tunis. It promises to be of considerable value in dry districts where irrigation can not be carried on. In the grass garden of the Department at Washington, D. C., this variety made a very fair growth last summer. It grew to be about two feet high and was in full bloom about the middle of July, but it produced very little seed. During the dry summer weather it still remained green, while the other alfalfas, which represented seed of 12 different varieties from different parts of the United States and from other countries, were suffering from drought and their leaves turning yellow. It can be distinguished from the other alfalfas by its somewhat differently shaped leaves, which are larger and of a lighter green color.

Our special agent at Abilene, Tex., Mr. H. L. Bentley, reports having had excellent success with this variety during an unprecedented season of drought. He secured an excellent stand, and the growth was vigorous from the start, but the dry months of July, August, and September caused the foliage to wither, and even the roots appeared dead. A rainfall on October 26, however, quickly revived them, and by November 15 a new growth of from 8 to 12 inches in height appeared, and by December 1 it had attained a growth of from 12 to 20 inches, looking as in the spring. With a normal rainfall he is satisfied that this variety of alfalfa will do well in his section without irrigation.

Twenty-four packages of the seed of oasis alfalfa were distributed in the spring of 1899, but up to the present time only 6 reports have been received. The following testimonies regarding it are not very satisfactory, as they do not represent its power to endure cold weather.

Mr. W. Atlee Burpee & Co., Doylestown, Bucks County, Pa.:

A finestand was secured and a growth of about 10 inches. Its leaves are more like those of the common white Dutch clover, being much larger and of a light-green color.

Mr. W. W. Gamble, Chotian, Teton County, Mont.:

This variety seemed to do very well the first year, but I can not determine its value until next year. The seed was sown broadcast and the land irrigated.

Mr. E. E. T. Hazen, Holyoke, Phillips County, Colo.:

A well-prepared sandy loam that had been in cultivation for 4 years was used. The seed was sown broadcast about April 22. It germinated quickly and attained a height of about 4 inches, but an epidemic of Russian thistle struck us and sapped the moisture from the soil, and this, together with dry weather from August to October, killed the oasis alfalfa.



FIG. 1.—VELVET BEAN IN AN ORANGE GROVE NEAR EARLETON, FLA. SEED SOWN IN DRILLS 5 FEET APART.

From photograph, August, 1898.



FIG. 2.—SAINFOIN; ESPARSETTE (*ONOBRYCHIS SATIVA*).

Hon. H. C. Warner, Forestburg, Sanborn County, S. Dak.:

The stand is perfect, but, as it is a perennial, its value can not be determined until another year.

BUR CLOVER (*Medicago maculata*).

An annual legume introduced from the Old World and now extensively grown in the Eastern and Southern States, and west to Texas and California. Its principal value is for winter and early spring pastures, and when once stock have acquired a taste for the burs which it produces they soon fatten on them. It is worthless for summer use and of little value for hay. The seed should be sown in October on rich, loamy soil and the plants will make good grazing by February or March. It matures in April and May, after which the ground may be plowed and cultivated in other crops during the summer. In the South it has been found very valuable to use in conjunction with Bermuda grass, as it matures its seed and dies at about the time the Bermuda grass starts into growth. Twenty-nine packages of bur clover seed were distributed during the fiscal year 1898-99, but so far only seven reports have been received. These show three failures, two unsatisfactory results, and two report it valuable as a forage crop. The following reports indicate to some extent the results obtained.

Mr. Alex. Raff, Orange Grove, Jackson County, Miss.:

A rich, sandy loam was used. The seed was sown broadcast about the end of April and covered 2 inches deep. Soon after it came up an extraordinary dry spell set in, and the clover gradually perished. I planted only one-half of the seed sent me, and will try again this winter with what is left. I believe the bur clover to be valuable for this climate, but think it should be planted in the fall or winter, as the summer sun is too much for the young plants.

Mr. E. M. Redwine, Newman, Coweta County, Ga.:

The seed was sown broadcast on well-prepared soil October 3, 1899, and harrowed in. It is now (December, 1899) up well and looks very promising.

A very similar and closely related plant, known as the California bur clover (*Medicago denticulata*), is proving to be very valuable in some parts of California. Although not so nutritious and palatable as either alfalfa or clover, it produces fine summer pasturage when other more important forage plants have become dried up by the summer heat. As the burs which it produces are prickly, they become entangled in the wool of sheep and thus decrease its value to a considerable extent.

VELVET BEAN (*Mucuna utilis*).¹

(Plate XI, fig. 1.)

The velvet bean is a native of India and has been known in the West Indies and the tropics of South America as an ornamental garden

¹ For full discussions on "Velvet Bean" see Bulletin No. 104, Alabama Experiment Station, and Circular No. 14, Division of Agrostology, U. S. Dept. of Agriculture.

plant for a great many years. It is believed to have been first introduced into this country by the Department of Agriculture for this purpose twenty-five or thirty years ago. It is an excellent plant for quickly covering unsightly objects or arbors. The Florida Experiment Station published an article on the velvet bean in a bulletin issued in 1895, with the suggestion that it might be a useful forage plant. Since then it has attracted considerable attention in the Southern States, where it has come into extensive use and is highly valued, especially as a fertilizer in orange groves.

The velvet bean is a trailing or climbing annual legume, with leaves resembling those of the cowpea and clusters of purple flowers at intervals of 2 or 3 feet along the stem. Later these form clusters of short, cylindrical pods, covered with a black velvety down which has given the plant the name of velvet bean. Each pod contains from 3 to 6 large, rounded, brown and white mottled seeds. It is an excellent soil renovator, having exceedingly large coral-like clusters of tubercles as large as a hen's egg. This mass contains about 6 per cent of pure nitrogen. The vines attain great lengths, sometimes growing from 30 to 50 feet in favorable localities. These may be cut for hay, which is greatly relished by all kinds of stock, or turned under as a green manure for the improvement of the soil.

Being a native of the Tropics, it matures seed only in Florida and the lower half of the States immediately along the Gulf coast. Wherever it ripens seed it is considered to be equal or superior to cowpeas, but where seed must each year be purchased it is not as valuable as that crop. In Florida the seed is sown in drills 4 feet apart, dropping from 2 to 4 seeds in hills 2 feet apart in the row. Planted in this way it will produce a mass of vines and foliage to the depth of 15 to 20 inches, covering the entire surface of the ground. From 20 to 30 bushels of shelled beans per acre is an average crop. It will completely destroy Bermuda grass, nut grass, and other troublesome weeds, and may perhaps check the Johnson grass.

During the years 1898 and 1899 thirty-four packages of the seed of velvet bean were distributed by this division. This distribution included experimenters in 8 different States. Very favorable reports have been received from Louisiana, North Carolina, Texas, and Virginia. Nineteen reports have been received, 3 recording failures, 2 unsatisfactory, 8 good, and 6 excellent.

The following reports from experimenters in different States will indicate something as to its value as a forage plant.

ALABAMA.

Mr. A. W. Orr, Deer Park, Washington County:

The ground was plowed and harrowed and the seed sown May 15, 1898, by dropping the seed into holes 2 by 6 feet apart made with a hoe. The velvet bean was in

full bloom by October 10, and produced about 3 or 4 tons per acre of good forage. My stock will not eat it, but my neighbor planted some seed I gave him, and his sheep are crazy for it and eat vines and all.

Mr. T. A. Foster, Braggs, Lowndes County :

The seed was sown in sandy soil, between rows of peach trees, April 15, 1899. I opened the beds as for cotton, and dropped 3 beans in hills 3 feet apart and covered with a board. The crop was hoed once and a sweep run through twice. It was in full bloom by August 10. Only about one-third of the crop matured, on account of frost. The beans that did mature were very good. If it would mature seed and its fertilizing properties were as good as cowpeas it would be very valuable, as the yield of vines is about four times that of peas on poor land. I shall give it further trial.

FLORIDA.

Mr. B. L. Hickman, Churchill, Marion County :

A thin, sandy upland soil which was full of weeds and trash was used. The seed was sown June 1 and July 15, 1899, by dropping 2 or 3 beans 18 inches apart in every fifth or sixth furrow. Having planted velvet beans two years before, this season I did not keep the Department seed separate, but planted it with seed saved from last year's crop. As I had an abundance of other forage, I did not cut any for hay, but left the vines on the land to improve it. The yield per acre is immense. I had about 40 bushels of seed from about an acre. Horses, cattle, and hogs eat the beans when soft. I am now feeding some hogs in pens on dry beans from last year's picking, and they eat them greedily and improve rapidly. I planted some seed this year which was 2 years old and found that it germinated equally as well as that saved from last year. A great many of the beans left in the field last year were frozen in the the winter, perhaps half. The balance sprouted and in many places made a good broadcast stand.

GEORGIA.

Mr. C. M. Booth, Monroe, Walton County:

A rich dark-red soil was prepared the same as for cotton. The velvet bean yields a luxuriant crop of vines, but frost came too early and caught the young beans before they were ripe. I think farther South the bean might do well, but here on parallel 34° the season is rather short.

Mr. R. P. Johnson, Plains, Sumter County:

The seed was sown in drills about the middle of April and covered with a small double coverer. They should have been planted earlier, as the frost got them before the seeds matured. The quality of the product is excellent and I think it would make hay equal to the peavine and be equally as good a renovator. This patch was followed with oats, and they were the finest and rankest oats in the field. The velvet bean is gaining favor in Florida and southern Georgia, and is fast coming to the front in this section.

LOUISIANA.

Mr. Irving E. Baker, Bastrop, Morehouse County:

A well-fertilized garden soil was plowed and harrowed and the seed sown about April 20, 1898. About July 1 it began to grow, and covered nearly all the fences, outhouse, and several trees by September 1. I have not harvested yet as I am waiting for the pods to dry. None, however, were fully ripe when frost came on September 15. It makes a tremendous growth of vines, running 40 feet. Horses seem to like it better than anything else.

MISSISSIPPI.

Mr. A. S. Herrington, Dollie, Jones County:

A sandy, pine-ridge soil in good condition was prepared as for cowpeas. The seed was planted June 23, 1899. Our test was to compare the bean with the cowpea. We planted some of each the same day, the bean occupying the land probably twice as long as the cowpea and making a third more growth. We deem it, however, inferior to the cowpea.

NORTH CAROLINA.

Dr. William Paul Moore, Jackson, Northampton County:

As to velvet bean, I am an advocate of it. I read a short article from Mr. Wilson, of Orlando, Fla., and was so impressed that I wrote him as to price of seed. I read his answer to several gentlemen, and we ordered a barrel. The weather was such that mine did not mature, but the foliage was immense. Capt. R. B. Peebles did not plant his until this year, and he is so much pleased that he will plant 10 acres next year. His vines now are about 4 feet deep and a mass of foliage. Everything eats it, as Wilson says. Cattle will leave other feed to devour it. Mr. John Moore, of this place, who ordered when I did, but did not plant until this year, secured a large growth. I gave some of the seed to different people for arbors and shade trellising, and to my surprise many of the seeds matured, so that they have again a pretty mass of vines at their doors. I had as many as 35 pods on one stem last year.

TEXAS.

Mr. Alex. McKee Robinson, Ada, Montgomery County:

I planted the bean April 1, 1898, with corn, using about 1 peck of the beans to the acre and about the same amount of corn as is usually used in a cornfield. I planted on poor, sandy hammock land, used no fertilizer, and plowed only once in two weeks after plants had come up. I was then so busy with my tobacco crops that I neglected the beans entirely—in fact, I gave the beans up to the weeds, but as I had planted in with corn, the vines wrapped around the stalks, and outgrew the weeds and everything else and made such a mass of vegetation that it was impossible to ride through on a horse. I can give you no idea of the number of bushels per acre the vines yielded, for I did not have any of the seed gathered until after the 15th of last December, and then only some 50 or 60 bushels, on account of not being able to spare the hands to do the work.

This season, however, I am giving the beans all the attention they need and am cultivating them in just the same manner as we cultivate corn. I am informed that the vines make fine forage and fertilizer, but have had no experience with them as such, as I raise the beans for the market and had no trouble in disposing of those I had gathered at \$3 per bushel. I believe that the bean will do better this year than last on account of its having had one year's growth in this section. Last spring I planted a few beans by the side of the chimney at my home and fertilized a little with cotton seed meal. The vines are now about 30 feet up the side of the chimney and are still growing very rapidly.

VIRGINIA.

Mr. C. H. Constable, Warsaw, Richmond County:

The velvet bean made a tremendous growth and had a very pretty bloom, making a handsome vine for the garden. It made a nice load of hay from the seed sent.

When cutting it I found one plant well advanced in seed and covered it with pine brush; the beans are well filled but not quite dry yet. I will let you know next year if they germinate, and if they do we may be able to raise them in Virginia.

Mr. J. M. Hughes, Claremont, Surrey County:

A good clay loam was plowed in March and well prepared. The seed was sown May 15 in rows $3\frac{1}{2}$ feet apart and 8 inches in the rows. By October 27 there were many full-sized pods but none ripened. As the frost ripened the vines I cut them for feed. From the seed received I planted about 10 square rods and had about all two good horses could draw (green). As to its value for forage, I think if the seed were planted in hills with corn to hold up the vines there would be few plants that would equal it, and had I planted them earlier I think some would have ripened.

SAINFOIN, ESPARCETTE, (*Onobrychis sativa*).

(Plate XI, fig. 2.)

A deep-rooting, perennial legume, 1 to 2 feet high, with round, striated stems and compound leaves. The leaflets are arranged in from 8 to 10 or more pairs with an odd terminal one. It is a native of the limestone districts of central, southern, and temperate Asia, and was introduced into England from France several hundred years ago, where it has been extensively cultivated on hilly, calcareous soils too barren for the growth of clover and alfalfa. In many parts of Switzerland where the finer grasses will not grow it is the main dependence for forage. Parkinson, as early as 1640, says that it is "generally known to be a singular food for cattle, causing them to give a store of milk."

The Hon. William H. Crawford, of Georgia, is said to be the first to introduce sainfoin into the Southern States about the year 1820. Strange to say, it is but little known throughout the country at the present time. This is chiefly due to the fact that it is very difficult to establish. The plants are very tender when young and easily killed. In order to insure success, the soil must be thoroughly drained and friable and the seed sown broadcast on the surface and thoroughly rolled. The crop should not be pastured or cut the first season, but when once well rooted it will endure pasturing and cutting for a long term of years. When made into hay it should be cut as soon as the first flowers appear. The quality of the hay will then be more nutritious and palatable, the second crop of foliage more abundant, and its duration prolonged. It is a strong food and good for working horses. Cattle are also fond of it when cut green, and sheep are said to highly relish it. Our special agent at Abilene, Texas, reports that although he did not sow it until May, he secured plants 12 to 18 inches tall, which stood the dry weather better than the vetches, clovers, or alfalfas, and quite as well as sulla. He thinks that there is no better forage plant for barren hills or hillsides. Twelve packages of the seed of sainfoin have been distributed and 5 reports received.

Mr. F. A. English, Farmington, Whitman County, Wash., reports:

The seed was sown by hand May 1, 1899, on well-prepared black loam, summer followed. Only one-third of a stand was secured, but it is now (November 1) in

fair condition for winter. From my former trial in 1896, I should judge that sainfoin may prove to be a valuable forage plant for this country. The plants are vigorous and it has done well on a small scale.

Mr. Jas. K. Metcalfe, Silver City, Grant County, N. Mex.:

The seed was sown broadcast in May and in August on rich gravelly soil and covered with a heavy garden rake. It produced about half a ton to the acre, and grows about like alfalfa if well irrigated. Nothing will eat it until it is hard frozen. I think it would make a good late winter pasture, as horses, cattle, and sheep eat it to the ground in winter, but in summer time they simply walk through it and only smell of it.

METCALFE BEAN (*Phaseolus retusus*).

(Plate VI, fig. 2.)

A prostrate, often trailing, legume, with a very large taproot, compound leaves, and purplish flowers. It is found growing wild along the mountain streams of western Texas and New Mexico. The root is considered among the natives as one of the best blood purifiers. Mr. James K. Metcalfe, of Silver City, N. Mex., was the first to introduce this plant into cultivation a few years ago. He secured a few seeds from the mountains in New Mexico and planted them in his garden. In 1897 the Department received 5 seeds from him and later 50 more. Such excellent success crowned his efforts that he offered to let the Department have 20 pounds of seed. This was secured from him at the rate of \$5 per pound. Twenty-two packages of the Metcalfe bean have been distributed to the following States and countries:

Arizona, Florida, Nebraska, New Mexico, Oregon, Pennsylvania, Texas, Utah, Washington, Cape Colony, Tunis, Madeira Islands.

Our special agent in charge of grass and forage plant investigations at Abilene, Tex., reports as follows:

It is a prodigious grower of vines, but there were no indications of flowers or seed pods. I am afraid the season here may not prove long enough for the production of flowers or seed. Some of the vines by July 1 grew to be from 8 to 12 feet long. Then the hot and dry winds began and continued for many weeks. Up to August 1 the vines held their own fairly well, then they gave way rapidly and by September 1 even the roots were dead. I shall try the Metcalfe bean again, however, another season and am confident good results will follow with a normal season. At all events, with my present experience, I commend it highly for soiling and hay purposes.

Our special agent in the State of Washington also reports having succeeded in producing an abundance of vines by the use of irrigation, but the seed did not mature.

In the grass garden of the Department at Washington, D. C., the Metcalfe bean germinated, but made a very slow and feeble growth. Some few pods were produced, but these, together with the leaves, turned yellow with the approach of slight frost in October and dropped off.

Mr. Metcalfe recommends the following method of harvesting the bean:

Take a sharp hoe, clip them at each hill and let them dry for one or two days. Then rake with horse rake and put into small cocks. When dry, haul and stack. If wanted for hay, cut when about half the pods have turned yellow.

The following letters from Mr. Metcalfe and the testimonials from other experimenters will indicate its value as a forage plant:

JANUARY 23, 1898.

I send you in this letter 50 Metcalfe beans. I am satisfied it is our coming forage plant. Few plants here are more relished by stock; even deer climb the cliffs for it. Be sure and plant the bean in rich deep-tilled land, about as you would for watermelons.

Yours, truly,

JAMES K. METCALFE.

NOVEMBER 10, 1898.

I have only 30 pounds of beans (*Phaseolus retusus*). I had bad luck with them. We had 8 inches of hail in June, which cut off every leaf and tender ends of the vines. The vines had to make a new growth. Those from beans planted on the 15th of May were a sight to look at. They were simply shingled with bean pods, but the frost killed them all and left the green pods lying on the ground side by side, like myriads of small fishes. If they had only ripened, I believe I would have had over a ton of beans. The 30 pounds which I secured were nearly all from 60 2-year-old vines. If the hail had not hit them, I believe they would have produced nearly 100 pounds of seed. Next year, without hail or frost, I will have several tons. It is a sure producer and an excellent feed. Five or six hundred plants to the acre the second year will mat the ground with vines and beans. Cattle and sheep will quit any kind of feed for it. They even lick up the leaves. Hogs eat it ravenously. It must be a rich food. Some of my vines measured $13\frac{1}{2}$ feet long. When we consider that so few beans will cover an acre of ground, and make such a yield of fodder and beans, we must believe that it is something wonderful.

Yours, truly,

JAMES K. METCALFE.

Mr. J. S. Argobrite, Los Angeles, Los Angeles County, Cal.:

A rich, sandy loam was plowed and harrowed and irrigated 4 times, using as much water as would grow a good crop of melons. The seed was sown May 2 in rows 4 feet apart and 2 feet in the row. The crop was cultivated once when the plants were 1 foot high. It was not harvested, but pastured to stock, as it was impossible to use a machine, owing to its prostrate growth. It was in full bloom July 25, but it did not ripen seed. The estimated yield of vines was about 4 tons per acre. The average growth was about 5 feet long. It is not a true climber, but runs over the ground like a melon, and is of no more value than the ordinary pole bean. Another small plot was sown on sandy soil and not irrigated. To date (November 1) it has made a growth of 1 foot and is still green and growing with many blossoms, but no seed.

W. Atlee Burpee & Co., Doylestown, Bucks County, Pa.:

A heavy clay loam was plowed and harrowed. The seed was sown May 3 and planted to poles set 4 by 4 feet apart. A horse cultivator was used. By September 8 the plants had a running growth, with rather thick, smooth, light-green leaves. It is only now starting to run freely and showing flower buds, but no pods have set.

Mr. B. Fritz, Blue Springs, Gage County, Nebr.:

The seed was sown on a well-prepared loamy soil May 15, 1899, in rows 8 feet apart with hills 4 to 6 feet apart in the rows, 1 seed in each hill. It was cultivated

with a small garden rake and a hoe. The date of full bloom was from the 10th to the 15th of September, but it did not ripen on account of frost about September 25. The vines were set full of pods and spread over the ground from 6 to 8 feet in every direction. Cattle and horses will eat them and seem to relish them.

Prof. A. J. McClatchie, Experiment Station, Phoenix, Ariz.:

A gravelly loam was used which had been thoroughly ploughed and harrowed. The seed was sown April 12, 1899, in hills 3 by 3 feet, and cultivated until the runners prevented. It blooms in August. As the Metcalfe bean is a perennial, it is too early to give results and estimates of value. The tops died down during September.

Mr. J. A. Mickelson, Elcampo, Wharton County, Tex.:

The seed was sown March 25, 1899, on well-prepared partly black sandy soil. Furrows were made with a garden hoe and the seed covered about 1 inch deep. It seems as if every seed germinated. I cultivated once by running a sweep between the beds, which were 4 feet apart. The bean grew well and had long vines, but unfortunately the Brazos flood of June and July affected us here in this community, though only by heavy rains, which scalded the majority of crops here and killed the Metcalfe bean. I am under the impression, however, that the bean would prove valuable here.

CRIMSON CLOVER (*Trifolium incarnatum*).¹

An erect, tufted, rapid-growing, annual legume from 1 to 2 feet high, with soft hairy leaves and usually bright scarlet flowers in elongated heads. It is a native of the Mediterranean region, and although it has been long cultivated in the warmer portions of Europe it has only recently come into prominence in this country. In the Middle and South Atlantic States this clover is one of the best crops that can be grown for forage and soil renovation. The general results of investigations carried on in the North and Northwest show that it is too tender for that climate and is less valuable than red clover. It is an excellent crop for use as hay, soiling, pasturage, silage, green manure, and as a cover crop. The hay when well cured is superior to red clover, has a somewhat higher percentage of digestibility, and is relished by all kinds of stock. On dairy farms it is especially valuable for soiling purposes, as it is ready for use some time before red clover, and at a time when there are few other crops at hand. In the early spring it makes excellent pasturage either alone or in conjunction with winter rye or rape. The quality of ensilage which it produces is better than that from most other leguminous plants and is highly valued for feeding to dairy stock. When used as a green manure, it exerts a most beneficial effect on the condition of the soil, adding much humus and nitrogen, as well as other valuable elements of plant food. As a cover crop it can hardly be surpassed. When sown after the last cultivation, it will serve to prevent the soil from leaching out or washing badly, to conserve the moisture during the long periods of dry weather, to reduce

¹ For full discussion of Crimson Clover see Circular No. 17, Division of Agrostology, and Circular No. 18, Division of Botany, Department of Agriculture, Washington, D. C.

the amount of labor necessary to keep weeds in check, and to supply the soil with an abundance of nitrogen.

Forty-three packages of crimson clover seed have been distributed for trial, but most of it in the spring of 1899, so that the number of reports are few.

Twelve experimenters have reported, and out of these there were 7 failures, 3 unsatisfactory, and only 2 good reports.

Mr. P. S. Early, Mockville, Davie County, N. C.:

The seed was sown October 1, 1897, on rich red clay soil, which had been thoroughly prepared by deep plowing and harrowing. It was cut about April 25, 1898, and yielded splendidly at about 2 tons to the acre. The quality of the forage is good, and for an early green crop the very thing for this section.

Mr. George Williams, Potomac, Prince Williams County, Va.:

I planted the crimson clover September 20, 1899, with a garden hoe, and made the ground in fine condition. It is now (December, 1899) looking well and promising.

ALSIKE CLOVER (*Trifolium hybridum*).

A common, perennial legume, 1 to 3 feet high, with branching leafy stems bearing white or rose-colored flower-heads. It is especially adapted for cultivation in wet meadows or marshy lands, and will not withstand severe drought. The leaves are slightly bitter, and on this account the forage is not so well liked by stock as that of red or white clover. As it can endure very low degrees of temperature, it can be cultivated in the far North and in high altitudes very successfully. Twenty-three trial packages of the seed of alsike clover have been distributed from this division since 1896, but only five experimenters have reported the results obtained, and of these only three were favorable.

Mr. W. H. Heideman, Kalispell, Flathead County, Mont., says:

A rather moist, rich, sandy loam was used, which was plowed and harrowed twice. The seed was sown without a nurse crop May 4, 1898, then smoothed with a lever harrow and rolled. As the season was cold and rainy, it did not mature seeds, but the quality of the fodder was good. None of it was killed out during the severe winter weather, and it is now pretty well demonstrated that clover can be made a paying crop here when grown for forage, but questionable as to the production of seed. It grew very heavy, but not very tall. The yield would be at least one and one-half tons to the acre.

RUSSIAN RED CLOVER (*Trifolium pratense* var. *pallida*).

A large quantity of the seed of this variety was obtained for the Department through Prof. N. E. Hansen in 1898 from the experiment station at Valnjka, province of Samara, Russia. During the years 1898 and 1899, 344 3-pound packages were distributed by this Division through the Section of Seed and Plant Introduction. This distribution includes experimenters in 37 different States, and 152 experimenters have reported the results of their trials. Very favorable reports have been received from Illinois, Indiana, Kansas, Michigan, Minnesota,

Montana, Nebraska, New York, Oregon, and Wyoming, but longer experimentation is necessary before we shall be able to say whether it is of any more value to the country than the common red clover. The following are a few of the reports from experimenters who have already found that it is hardier and more drought resistant than the common red clover:

ILLINOIS.

Mr. A. B. Cundiff, Blairsville, Williams County:

A clay loam was plowed the latter part of March, 1898, and seeded to oats. The clover seed was sown on the oat ground about April 20, 1898, and harrowed one way. The clover came up nicely and made a rapid growth and at the present time is making a good pasture. I regard it as a valuable addition to our varieties of clover, both for pasture and hay.

INDIANA.

Mr. Henry Wehry, North Vernon, Jennings County:

A clay loam in medium condition was plowed in the fall of 1897 and left in the rough furrow. The ground was harrowed twice in the spring with a tooth harrow and the seed sown March 9, 1898, then harrowed again with a spike harrow. This variety grew about the same as ordinary red clover, being about 8 inches high. With the exception that it may be a little hardier and more drought-resisting I can see no difference between it and the common red clover grown in this country.

KANSAS.

Mr. John B. Harman, Valley Falls, Jefferson County:

A clay loam on a northeast slope was pulverized 3 to 4 inches deep, then plowed, harrowed, and rolled. The seed was sown June 4, 1898, with a cyclone seeder, then harrowed in, rolled, and brushed lightly. It came up in about four days, but barely lived through the dry months of July and August. It looks green now (October 24), and is as high as the stubble. I think it is better than our common clover, but the weather was so cold and wet that the ground did not get into condition to sow the seed in time to give the clover a fair show.

MONTANA.

Messrs. William W. Gamble & Sons, Choteau, Teton County:

A gravelly loam on bench land was plowed and harrowed well. The seed was sown broadcast with a hand seeder May 19, 1898. The clover wintered all right and was in full bloom by July and ripe in August. The quality of the product is good. It grows well and yields heavily with us. I think it is of considerable value.

Mr. A. H. Geyer, Victor, Ravalli County:

A sandy loam with a clay subsoil was used. It was well drained, mellow, and in fine condition. The seed was sown about the middle of April. The crop was irrigated through June and July. It had fully matured by the beginning of August. The yield per acre was from 1 to 2 tons, according to the condition of the soil. The product is of fair quality, about 2 feet high and somewhat coarse. The leaves are small and pointed and similar to alfalfa. It is a fair forage plant.

Mr. W. H. Heideman, Kalispell, Flathead County:

A medium, rich, sandy loam was plowed and harrowed twice before seeding. The seed was sown broadcast May 4 without a nurse crop and covered by rolling



FIG. 1.—HAIRY VETCH, GRASS GARDEN, WASHINGTON, D. C.



FIG. 2.—AUSTRALIAN SALTBUCH IN GRASS GARDEN, WASHINGTON, D. C.

the ground. This clover stood the severe winter of 1898-99 and came out in fine condition, making a fine crop. The estimated yield was about $2\frac{1}{2}$ tons to the acre. The quality of the product was good. I am still more convinced that we will succeed in growing clovers in this section. This clover makes a very strong growth and seems to stand the drought well and is perfectly hardy. It is looking green and healthy at this time (November 18, 1899), but I can not yet say whether it will produce seed here.

Mr. C. H. Williams, Deer Lodge, Deer Lodge County:

A sandy loam with a clay subsoil was plowed and harrowed. The seed was sown broadcast May 15, 1898, and covered lightly with a harrow. The crop was irrigated, and came into full bloom about August 15, 1899. The yield per acre would be about $1\frac{1}{2}$ tons of first-class hay. It grows rapidly and will be of great value as winter feed for sheep or cattle.

Mr. C. C. Willis, Plains, Missoula County:

A sandy soil with a clay subsoil on bench land was used. Bunch-grass land that had been grown to weeds four or five years was plowed up and prepared for the clover. The seed was sown broadcast with oats May 24, 1898, and thoroughly harrowed in and rolled. It came up in a short time. We had a very good season, with plenty of showers in June, and the clover was in bloom by July 15. The yield per acre was from 2 to $2\frac{1}{2}$ tons. The quality of the product was good and stock ate it well. It is a vigorous grower and I think it will be a good forage plant, as dry weather seems to affect it very little.

SOUTH DAKOTA.

Hon. H. C. Warner, Forestburg, Sanborn County:

A black, sandy loam was plowed deep and harrowed. The seed was sown broadcast April 24, 1898, and covered with a brush harrow. The stand was perfect, but a cold dry fall and cold open winter killed 50 per cent of it. The remaining plants, however, made a good growth this season until July, when they were attacked by grasshoppers which ate the foliage and blossoms as fast as they appeared. It is 5 per cent hardier than the common red clover growing by its side.

HAIRY VETCH (*Vicia villosa*.)¹

(Plate XII, fig. 1.)

A leafy, annual, trailing, leguminous plant, which has been cultivated in Europe for over fifty years, especially in Southern Russia, Germany, and France. It was first introduced into this country in 1847, but its cultivation was neglected. About twelve years ago it was reintroduced by this Department, and since then it has been widely distributed and successfully tried in various parts of the United States. The results of experiments with it on the trial grounds of the Department at Washington, D. C., prove that it is quite hardy and continues to grow all winter during periods of open weather. At the Mississippi Agricultural Experiment Station the hairy vetch has given heavy annual crops on the same ground since 1888 without receiving any

¹For full discussion of Hairy Vetch, see Circular No. 6, Division of Agrostology, Dept. of Agriculture, Washington, D. C., and Bull. No. 105, Alabama Experiment Station.

special care, the plants self-sowing the plat each season. It will grow readily on poor sandy soils, but is most profitable as a forage plant on rich and well-prepared land. Poor lands can be supplied with the necessary plant food for the growth of other crops by growing hairy vetch for several years. It forms a mulch on the land all summer by its matted growth, kills the weeds, and mellows the soil as much as any hoed crop, without the labor required for the latter.

Hairy vetch may be sown any time in the spring in the North, Northwest, and East, but for the South and Southwest it has been found more successful to sow in the fall, some time in September or October. It should be sown broadcast or with a grain drill at the rate of 1 to 1½ bushels to the acre. The seed is yet quite expensive, which, to some extent, prevents it from occupying a prominent place in American agriculture. However, a number of our correspondents are reporting the successful raising of seed, and it seems quite probable that this country will soon be producing sufficient seed for its own use.

Hairy vetch is eaten with relish by all kinds of stock. It is valuable for soiling, ensilage, green manure, cover crop, and for hay, although for the last-named purpose it is difficult to cure on account of its dense habit of growth.

Excellent reports have been received in regard to its drought-resisting qualities and its adaptability to our climate from Colorado, Georgia, Idaho, Indiana, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, Montana, New Mexico, North Carolina, Pennsylvania, South Carolina, South Dakota, Wisconsin, District of Columbia, and Mississippi. The seed was distributed to experimenters in 40 different States, and reports have been received from 27 States. Thirty-four packages of the seed of hairy vetch were distributed during the fiscal year 1896-1897; 332 packages during 1897-98, and 98 packages during 1898-99, making a total of 464 packages since 1896.

The request to the experimenters for a report as to their success or failure was complied with by 206 farmers out of the 444 receiving seed. Out of these, 86 resulted in failures, 43 were unsatisfactory, and 76 reported having had good results, while 6 speak of it in the very highest terms.

The following reports from the various States will indicate its great value throughout the country. In many instances only the salient points are extracted from the reports, leaving out the kind of soil and method of sowing and cultivation adopted:

ARKANSAS.

Mr. J. B. Nixon, Charleston, Franklin County:

When sown by itself it is of a spreading nature, and to secure the best results should be sown with wheat, or in the spring with oats, barley, or spring wheat. I think it will be an acquisition to the forage plants here. It did not have a fair trial last season, owing to the excessive drought.

CALIFORNIA.

Mr. Andrew Boddy, Monrovia, Los Angeles County:

The vetch is good as a forage to cut green and feed to stock, and if irrigated can be cut several times in a season. I had some experience with this plant in Canada in 1868 and 1869, and it gave good satisfaction at that time.

Messrs. Guill Brothers, Chico, Butte County:

The growth was very rank, some of the vines being $7\frac{1}{2}$ feet long and full of pods. I should think it would be fine for sheep and hog pasture. I shall try it along that line another season.

Mr. P. H. Murphy, Perkins, Sacramento County:

Although all the other varieties failed to grow, this vetch made a good growth during the summer months on all the different soils. I found it excellent for green feed for hogs and cattle. If planted in January in our climate, it will make a good crop. I consider it a good green soiling crop. It does best when sown with barley or oats.

Mr. K. J. Provost, Grafton, Yolo County:

A rather heavy clay land near a river bank was used. The soil was plowed once and put into good condition. The seed was sown March 2, 1898, and then the land was harrowed and cross harrowed. The vetch made a vigorous growth. After the first cutting it grew again over 2 feet tall and formed a dense matted growth. From the growth made and the relish with which cattle eat it, I believe it to be a valuable adjunct to our crops.

GEORGIA.

Mr. E. J. Hartman, Orr, Gilmer County:

The hairy vetch made a feeble growth at the beginning, but came out well later on, and is now showing satisfactorily.

Mr. T. A. Stafford, The Rock, Upson County:

The yield per acre and quality of the product were very good. I think it might be worth quite as much as any good hay. The chickens and pigeons got most of the seed.

IDAHO.

Mr. Ellis M. Cameron, Postfalls, Kootenai County:

A gravelly loam was used, which had been plowed, harrowed, leveled, and rolled. The seed was sown with a press drill about the middle of April, the first of May, and the middle of May. It was then brushed and rolled as the plants showed above ground. The yield per acre was about 2 tons, and the quality of the product excellent. I believe it will make an excellent plant for soiling, for a green manure, and probably would make good ensilage. It is a very valuable plant for the dairymen of this country, and as a catch crop for late pasture.

ILLINOIS.

Mr. A. R. Downy, Rapids City, Rock Island County:

The seed started well, but was severely tested by the cold winter of 1898-99, which, by the way, was the coldest known for years. The following season the growth was fine, and I believe the vetch will prove valuable.

INDIANA.

Miss Kate A. Drake, Elkhart, Elkhart County :

It must be a valuable plant for our section, as it defies drought and cold, and cattle, horses, hogs, and hens are very fond of it.

Mr. Henry Wehry, North Vernon, Jennings County:

A clay loam of medium quality was used; it had been plowed 8 inches deep, heavily manured, and pulverized with a spike-tooth harrow. The seed was sown with a wheat drill at the rate of 44 quarts per acre May 21. The vines were cut October 15, when they were still in full bloom. No pods had formed, and the blossoms all wilted and fell off. I think it would have yielded about 2 tons of dry hay per acre. Some of the vines were 10 feet long, and it was the hardest stuff I ever undertook to cut. The forage is of good quality and liked by all kinds of stock. It would make a fine crop to turn under. The greatest drawback is the expense of the seed.

IOWA.

Mr. E. L. Hayden, Oakville, Louisa County:

The seed did not germinate well, and the plants grew slowly until the 10th of July. After that date they grew very fast until the time of cutting. The second growth is now (October 17) about 6 feet and in full bloom, with some of the pods ripe at the same time. I have been pasturing it with calves. If the seed was not too costly, it would probably pay to sow it with spring grain for fall pasture or alone for green manuring.

KANSAS.

Mr. J. R. Norton, Morantown, Allen County:

The yield was heavy, but I did not gather it. Rabbits and sheep gnawed it all winter. It came up itself this spring and made a lusty growth. I think it is a valuable plant to have around. Perhaps it would make good hay.

Mr. George James, Concordia, Cloud County:

It made a good growth, but the dry weather came when it was in full bloom. I wanted the seed, so I let it go to ripen, but it did not last long when the hot winds struck it. I did not get any seed.

MINNESOTA.

Mr. S. M. Warman, Sandstone, Pine County:

The seed was sown broadcast May 19, 1898, on well-prepared new land. It grew well, and is perfectly green still (October 15), with many ripened pods with seed in them, equal in size to the seed sent. Without doubt it will be a very valuable crop to stock raisers and dairymen. I shall not be without it in future. The vines grew 15 feet long.

MONTANA.

Mr. E. Beach, Augusta, Lewis and Clarke County:

A dry, gravelly bench land was used that had been in cultivation for several years. The soil was plowed and harrowed, and the seed sown broadcast June 5 and harrowed in. It was in full bloom August 20, and was cut for hay. It is an excellent and very nutritious feed. The yield of hay is about 1 ton per acre. It also has excel-

lent pasture growth, but as it is an annual plant, it is not desirable for that purpose in this country. On account of its growing on the ground like a vine it is not easy to harvest.

Mr. C. C. Willis, Plains, Missoula County:

The hairy vetch grows well here, and I believe it will thrive on our bench lands. Stock keeps it grazed close to the ground.

Mr. Emory Vine, Miles City, Custer County:

The hairy vetch grew well and kept blooming and ripening seed at the same time until cold weather. The yield per acre would probably be about 3 tons. Some say nothing will eat it, but I know better. It is a good drought resister, and will be better liked when better known. It is difficult to harvest, as it interlaces so, but it makes a good pasture, particularly for hogs.

NEBRASKA.

Mr. E. P. Savage, Sargent, Custer County:

The growth of the vine was heavy, but little seed was secured, as much of the seed had fell out of the pod while the plant was still in bloom. Cattle and horses eat the straw readily. I believe it to be a good plant for soiling and for hay.

Mr. Alfred Shirley, Weeping Water, Cass County:

This is an extraordinary forage plant. Hogs and all other kinds of stock eat it readily and prefer it to anything else, both when green and cured. I do not like to use it for hay, as it is so difficult to cure.

NEW MEXICO.

Mr. J. G. Kello, Aztec, San Juan County:

The yield per acre would probably be about 1½ tons. It is a first-class forage; cows and all other stock eat it eagerly. The experiment was made for the purpose of getting a crop of hay, and at the same time a stubble to turn under that would add nitrogen to our sandy soils, which are rich in phosphoric acid and potash, but poor in nitrogen. This forage plant so far has made a better showing than alfalfa, Canada peas, cowpeas, or red clover, as it germinates better than any of the above and makes more hay in less time. It also withstands drought better. For a short rotation I believe it will prove better than any of the above for our soil and climate. I am of the opinion that hairy vetch will have to be planted in the fall in order to mature seed here.

NORTH DAKOTA.

Mr. D. N. Dalrymple, Kelso, Traill County:

The vetch made a very rank, rapid growth, and if sown with oats would make an excellent soiling crop. The greater part of it was still green when the ground was frozen.

Mr. W. R. Gluyas, Hofflund, Williams County:

It looks as if it would make 4 tons to the acre. It makes an excellent growth, some of the vines being 6 feet 5 inches long. Horses did not seem to care for it, but it will no doubt prove of considerable value for such stock as will eat it.

Hon. J. A. Power, Power, Richland County:

The hairy vetch was mown July 15. After this it grew again and made a thick growth and matured seed, which was not gathreed. It stayed green until late in the fall, and was greedily eaten by horses and cattle. I believe it may have value if it will stand the climate and reseed itself.

OREGON.

Messrs. J. P. & J. O. Stemmler, Dora, Coos County:

It makes an enormous growth, branching out into runners 10 to 12 feet long. There was a heavy frost here last night, and I thought the vetch was killed, but am pleased to say it is not, but is in full bloom. One drawback is that, I fear, it will not ripen seed in this climate. It is splendid as a cover crop among trees. The yield per acre was about 3 tons.

PENNSYLVANIA.

Mr. Joseph H. Brinton, Chester County:

I experimented with *Vicia villosa* and found it admirable for subduing weeds. In forty years' experience of farming I think it the most remarkable forage plant. It seems proof against the extremes of heat and cold. All kinds of stock like it. The roots go down deep into the ground, and are covered with tubercles about the size of a grain of shot.

SOUTH CAROLINA.

Dr. J. E. Rickenbaker, Orangeburg, Orangeburg County:

On rich soil this plant makes a very rapid growth. It is well adapted for this section, but the seed is difficult to gather and the large quantity required for seeding will likely prevent its ever becoming very popular.

SOUTH DAKOTA.

Hon. H. C. Warner, Forestburg, Sanborn County:

The seeds of hairy vetch germinated well. The average length of the plants was $9\frac{1}{2}$ feet. It was cut green and fed to horses, hogs, and cows, and was relished by all. I am well pleased with it, and am sure it will prove valuable for forage.

TEXAS.

Mr. Arnott West, Brownwood, Brown County:

I gave this plant no care, as there was such a small amount of seed. It produced about 2 to $2\frac{1}{2}$ tons per acre. I let my milch cows graze on it, and they kept it eaten to the ground from July on. It did well for the chance it had. It will make splendid hay for this country.

VIRGINIA.

Mr. George Williams, Potomac, Prince William County:

The seed was planted in drills, between corn. I judge by the looks of the plat that every seed grew, and after the corn was taken off cows were turned into the pasture, and they seemed to be fond of it. In spite of the cattle eating it off each day, one can see the green foliage 30 rods away.

WASHINGTON.

Mr. F. A. English, Farmington, Whitman County:

I should consider the hairy vetch a good plant for dry soils of poor quality, but no comparison to brome grass as a success. Under the adverse circumstances it was remarkably good. There was barely an inch of rainfall from June 1 to September 15. I believe the plant would do better on moister ground and with occasional showers during spring and summer. I can recommend it for its staying qualities.

Mr. J. M. Scott, Kiona, Yakima County:

After the first two or three weeks the hairy vetch grew rapidly. It was frequently irrigated and soon spread over the ground, making a tangled mass of vines. It probably would yield from 2 to 3 tons per acre. The vines seem to be a rich feed. From what I have seen of this plant I should think it will withstand a great deal of drought and live, but to make a paying crop it needs a reasonable amount of water. While the plants were young all kinds of stock seemed to be very fond of them, but when the vines matured they did not seem to relish them. Mr. W. D. Taville, of Kiona, who has a wheat farm upon the high plateau known as Horse Heaven, just south of the Yakima Valley, sowed some hairy vetch this year, which, he says, did fairly well without irrigation, but there is more rain there than in the valley and the soil is better.

WISCONSIN.

Mr. J. F. Jensen, Waupaca, Waupaca County:

I have been very successful with the hairy vetch. The seed was sown in May in 1898, and made a good growth of hay. It lived through the severe winter, and this year grew to a height of 4 feet. I cut about 10 square rods and thrashed out about 1 bushel of good seed. I think this is a fine crop to grow for the improvement of our soil.

STOLLEY'S VETCH (*Vicia leavenworthii*).

A native annual legume, with small leaves and trailing stems similar to the common vetch. It is found growing wild in the granite regions of central and western Texas. Its value as a forage plant was first noticed by Mr. George Stolley, of Burnet, Tex., a few years ago. It is said to withstand drought remarkably well, and cattle and horses are fond of it. As it is an early forage plant, appearing in the spring before even the needle grass starts, it will be especially valuable for supplying green food at a time when it is badly needed. In the counties of Parker, Callahan, and Burnet, Tex., it has given most satisfactory results, and promises to be one of the best winter and early spring forage plants for those districts. It is also valuable as a soil mulch and green manure. About 10 packages of seed, grown by Mr. Stolley, were distributed by this division in 1898-99. Several reports have been received giving only fair results. It has not been sufficiently tested to enable us to state its usefulness.

SALTBUSHES (*Atriplex*).¹

(Plate XII, fig. 2.)

The saltbushes are especially adapted for alkali lands where grasses and clovers will not grow, but they will also do well on nonalkaline soils. There are many species in cultivation, both native and introduced. A variety which is attracting a great deal of attention at the present time is the Australian saltbush. It is a rapid-growing, much-branched perennial which forms a dense mat over the ground to the thickness of from 1 to 2 feet. The leaves are small, about an inch long, and coarsely toothed along the margins. In a few weeks one plant will spread from 4 to 5 feet. The hard, somewhat pulpy fruits are produced in abundance throughout the season. They differ from many of the other saltbushes in not having the seed surrounded by a large, light fibrous covering, but have merely a very thin coating of pulp, which is tinged with red at maturity and dries out as soon as they fall from the plant. On the poorest and most stubborn arid soil, so impregnated with alkali that no other useful plant will grow, this saltbush has been known to flourish. It seems to have a remarkable number of virtues, including great frost resistance, palatability, heavy yield, sand-binding qualities, and the habit of spreading freely. Sheep are especially fond of this saltbush, and hogs eat it freely. A mixture of three parts of this forage with one part of common hay is readily eaten by horses and cattle. It is probable that under favorable conditions about 20 tons of green feed or 5 tons of cured forage could be produced from 1 acre. The introduction of this plant to owners of waste alkali lands has certainly been a great achievement. As it has almost the same nutritive ratio as alfalfa, it would seem that it must have nearly as high a feeding value. Von Mueller states that, in his opinion, many of the valuable qualities of the Australian wools are due to the abundance of this and other saltbushes in the regions in which the sheep are grazed. Owing to its thin, flexible stems it can be handled like alfalfa, while most of the other saltbushes are only fit for browsing. Of all the different species in cultivation in this country, this Australian saltbush seems to be the most promising, both because of its hardiness and the bulk of tender fodder produced.

In the grass garden at the Department of Agriculture, Washington, D. C., the Australian saltbush has produced a vigorous and widely spreading growth throughout the season. It is now fruiting abundantly, and extends 5 feet beyond the original plot which it has occupied for five years without reseeding or other care.

There are about 40 species of saltbush in the Western States, some of which will no doubt prove as valuable as those introduced from

¹ For full discussion on "Native and introduced saltbushes," see Farmers' Bul. No. 108, U. S. Department of Agriculture. (Agros. No. 55.)

Australia. They are known to be hardy as regards cold as well as resistant to alkali and drought, and are highly valued for grazing in alkali districts where little or no other vegetation exists.

Of the American saltbushes now in cultivation, shad scale is considered to have the most economic value. It is a robust, shrubby perennial, from 4 to 10 feet high, native to the high valleys and plains of Wyoming, Nevada, Arizona, New Mexico, and western Texas. The small, narrow, gray-green leaves and young branches are browsed by cattle, which sometimes eat it down close to the ground, leaving only the stump to branch out again into new growth. The seeds are produced in great abundance, often one-half bushel or more on a plant. These are much sought after by sheep, and are considered very fattening.

In the Southwest there are large sections of country where shad scale constitutes the chief forage plant. It is so much liked by stock that on the summer ranges it occurs only on rocky cliffs or other inaccessible points. On ranges which are not grazed through the summer, where the plant has an opportunity to seed freely, it grows in great abundance and affords excellent winter pasturage. It has proved its adaptability to soils impregnated with white alkali, and also withstands small amounts of the black alkali. Its resistance to cold adds greatly to its value. Since 1896 this division has sent out 248 packages of *Atriplex* saltbushes to different experimenters throughout the United States. Twenty-nine different States are represented in this distribution, which was as follows:

Shad scale (*Atriplex canescens*), 85 packages; gray saltbush (*A. halimoides*), 37; annual or bladder saltbush (*A. holocarpa*), 29; Australian saltbush (*A. semibaccata*), 20; Nelson's saltbush (*A. pabularis*), 19; slender-fruited saltbush (*A. leptocarpa*), 18; silvery saltbush (*A. argentea*), 16; round-leaved saltbush (*A. nummularia*), 10; bladder saltbush (*A. vesicaria*), 8; Nuttall's saltbush (*A. nuttallii*), 5; Utah saltbush (*A. truncata*), 3; sponge saltbush (*A. spongiosa*), 3, and spiny saltbush (*A. confertifolia*), 3. Of the 150 applicants for seed, 52 have sent in reports, and with the exception of 12, all report that the seed failed to germinate, or that only a few plants came up and soon died.

This failure to germinate the seeds is very probably due to the methods adopted in planting. If the seeds are harrowed in to the depth of 2 or 3 inches, or sown in drills in alkali soils, they usually rot before germination can take place. The primary rule to remember is that these saltbushes are plants of the desert. Their seeds start easily and rapidly, with little or no covering, but the soil must be warm and moist. At the California Experiment Station, as well as on the trial grounds of the Department at Washington, D. C., it has been determined that the seeds germinate better when sown directly on the surface without any covering. Some practical stockmen have had

good results in establishing saltbush on alkali ranges by sowing the seed on the ground when it was wet with heavy rains, and at once driving a flock of sheep over the land, thus treading the seed into the soil. In order to obtain a satisfactory stand, however, the heat must be adequate.

Almost without exception farmers who have attempted to cover saltbush seed on alkali soils have found that it rotted in the ground before germination could take place. For California the best time to sow is about the latter part of September or the beginning of October, when one is able to catch the first autumn showers. Plants may be grown by sowing the seed in boxes or garden beds, covering very lightly, and planting out the seedlings when a few inches high, several feet apart, on alkali spots. Many have followed this method with success, and thus have utilized every seed obtained. In districts where the seed is being experimented with for the first time, and in case of small lots, this method is to be recommended.

As the saltbushes are remarkable for their ability to adapt themselves to varied conditions, this method would enable the plants to become acclimated, and the seed would be more likely to germinate well. The California Experiment Station sums up the points in brief, as follows: Sow early, on the surface; press seed into the soil, but do not cover; protect from birds, which are very fond of the seeds.

Although no extensive experiments have been made with sowing saltbush seed on nonalkaline soils, yet it seems to be an advantage to cover them slightly.

WINTER FAT; SWEET SAGE (*Eurotia lanata*).

(Plate XIII, fig. 1.)

A half-shrubby perennial, 1 to 3 feet high, with numerous small gray leaves and slender woolly twigs. It is found growing wild throughout the Rocky Mountain region from British Columbia to Mexico. An important fact in regard to this plant is that it will thrive on both alkali and nonalkali soils. In western Texas and in the more arid regions of Arizona, Nevada, and Utah it is very highly valued for winter forage. The cottony seeds are produced in great abundance, and both seeds and stems are eaten greedily by all grazing animals; so that this plant is now almost exterminated wherever cattle have free range. It has been growing in the grass garden of the Department of Agriculture at Washington, D. C., for several years, and grows almost as well in dry as in wet weather, producing a fine growth of forage. Stock grazed on lands where winter fat occurs make a rapid growth, and are said to be remarkably free from disease, because of the tonic properties of the plant. Seed might be gathered by ranchmen and sown in the spring on land which had been disked or



FIG. 1.—WINTER FAT; SWEET SAGE (*EUROTIA LANATA*), NATIVE GROWTH.
From a photograph by A. B. Leckenby.



FIG. 2.—SAND DUNE FORMED BY SEASIDE BLUE GRASS (*POA MACRANTHA*) NEAR
SEASIDE, OREG.

From a photograph by F. Lamson-Scribner, 1899.

harrowed, and while it could not be cut for hay, owing to its shrubby nature, yet it would make excellent winter browsing for either sheep or cattle. Since 1896 thirty-eight packages of the seed of winter fat have been distributed by this division. Eleven reports have been received, but most of the experimenters seem to have had difficulty in growing it successfully under cultivation. Our special agent at Walla Walla, Wash., however, finds that it adapts itself readily to cultivation, producing an abundance of seed.

TSAMA WATERMELON (*Citrullus vulgaris*)

(Fig. 1.)

A few seeds of this variety were received from Professor MacOwan, government botanist for Cape Colony, and distributed to the Arizona and California experiment stations, with the hope that a quantity of seed might be produced for general distribution. The Tsama watermelon is a native of the Kalahari Desert, in South, Africa, where it is often the only supply of water for travelers crossing these arid regions. It is especially adapted to withstand great extremes of temperature and drought, and hence might be valuable for wide introduction through the deserts of Arizona and southern California.

Professor MacOwan writes:

The waterless regions would be impassable but for its perfectly tasteless watery contents. It is merely a variety of *Citrullus vulgaris* with tasteless and nonpurgative pulp. The vines grow rapidly and spread many feet, yielding a large quantity of round melons 4 inches or more in diameter.

Tsama watermelon has grown and matured in the grass garden of the Department of Agriculture at Washington. The California Experiment Station is now distributing the seed of this melon under the erroneous name of Khama watermelon, with the following notice:

This curious little stock melon came from the Kalahari Desert, in South Africa, and is said to grow well on exceedingly arid soil. At Pomona substation, without water, on sandy soil, it yielded at the rate of 22 tons to the acre. Cows and horses eat the melons readily.

At the experiment stations of Arizona and California it grew luxuriantly, as the following report will show.

Mr. J. W. Mills, foreman, Sub-experiment Station, Los Angeles, Cal.:

A reddish-brown, sandy loam was plowed 10 inches deep in October, 1898, irrigated in January, 1899, replowed in February, and cultivated until June. The seeds were planted in hills 12 by 24 feet between rows of fruit trees on June 5, 1899. The plants came up well and were thinned, leaving two in a hill. The crop was cultivated only once before the vines covered the ground. It was in bloom from July to October 1. In quality it is about on a par with the melon known as pie melon, stock melon, or citron. The vines grew about 12 to 15 feet long, producing from 120 to 160 melons per hill. The crop was harvested about November 1, 1899, when about one-fourth of the melons were ripe. The yield per acre if planted 15 by 15 feet would

be about 40,000 pounds. Cows and horses eat the melons readily. Hogs do not care for them. The melons when on the vine have a peculiar and bad odor, which passes away after they have been harvested a few days. The odor seems to come from the hairs that grow on the rind.

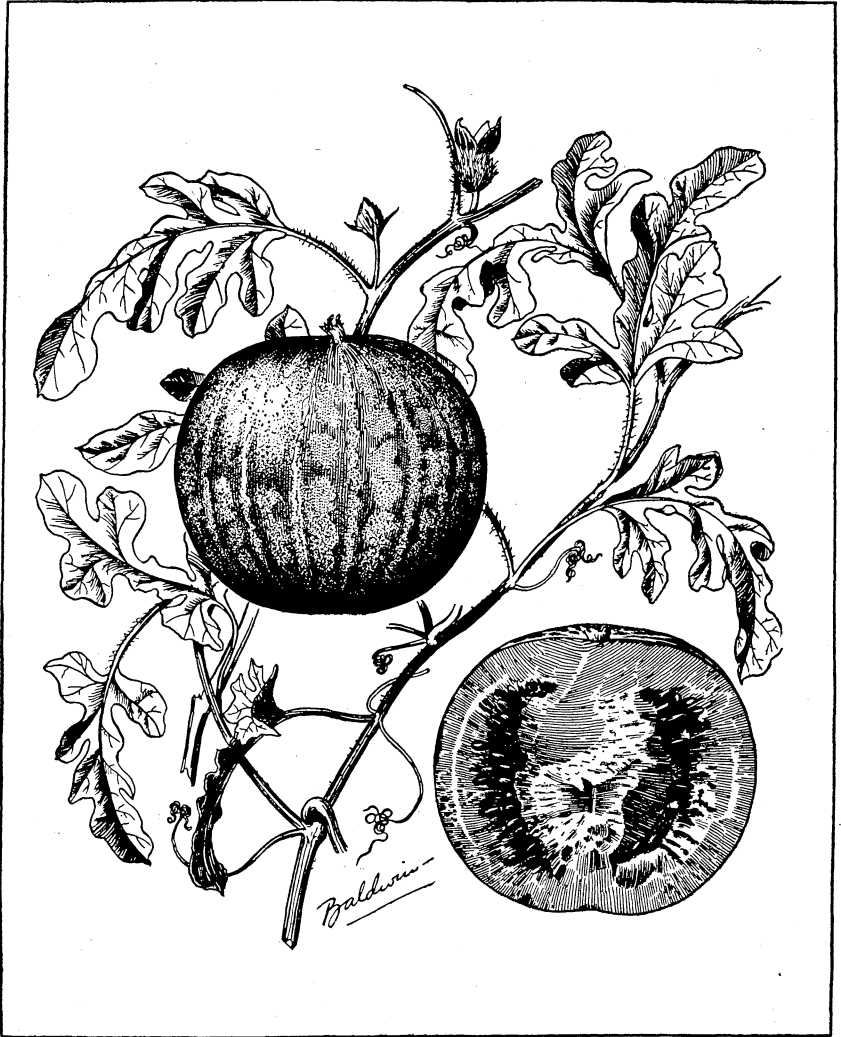


FIG. 1.—Tsama melon (*Citrullus vulgaris*).

Prof. A. J. McClatchie, Experiment Station, Phenix, Ariz.:

A well-prepared, sandy loam was used. The seeds were planted in rows 6 by 8 feet on April 10, and well cultivated during the early part of the season. The crop was in bloom by May, and ripe melons were produced during July, August, and September. It grows luxuriantly and is evidently good feed for stock. It seems to be suited to our climate and stands the drought well.